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United States
Environmental Protection
Agency

Region 4
345 Courtland Street, NE
Atlanta, GA 30308

EPA 904/9-78-012-A
JULY 1978

DRAFT



Environmental Impact Statement

**Occidental Chemical Company
Swift Creek Chemical Complex
Hamilton County, Florida**

**Resource Document
Volume I**

REPRODUCED BY
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GLOSSARY

- ARBOREAL**-A species inhabiting or frequenting trees. Used to indicate those animals whose occupancy of an area is limited by the presence of trees in which to feed, roost, or rest.
- ARTESIAN AQUIFER**-A geologic formation in which water is confined by an impervious confining layer under a pressure sufficient to raise the piezometric level above the top of the containing formation.
- ARTIFICIAL SUBSTRATES**-Clean surfaces suspended in a water body for the purpose of providing a consistent substrate from which to sample aquatic invertebrates and attached plants. Artificial substrates used in this study included trays of glass microscope slides for collecting periphytes and Hester-dendy samples for macroinvertebrates.
- AVIFAUNA**-The birds or the kind of birds of a region, period or environment. Used in reference to birds in general.
- BECK'S BIOTIC INDEX**-An index value based on biological findings and indicative of the cleanliness of a portion of a stream or lake with regard to organic pollution. Values may range from 0 to about 40 with lower values indicating higher levels of pollution. Was used in this study to provide qualitative comparisons among stations along Swift Creek and between the various streams sampled.
- BENEFICIATION PLANT**-A minerals plant that processes phosphate rock matrix to separate clays, sand, and phosphate rock and provides storage, drying, and shipping facilities for the product phosphate rock.
- BIOCHEMICAL OXYGEN DEMAND (BOD)**-A measure of the oxygen utilized in the bacterial decomposition of organic matter present in the stream.
- BIOMASS**-The total mass or weight of organic matter present in an area or beneath a unit surface area in a body of water. Often used as a relative indicator of productivity when comparing two areas or populations.
- COOLING POND**-A water pond used to remove process heat from process water by atmospheric cooling.
- CRITERIA AIR POLLUTANTS**-Those pollutants believed by the Secretary of Health, Education and Welfare to be harmful to health or public welfare. These currently include sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, hydrocarbons, and photochemical oxidants.
- DISSOLVED OXYGEN (DO)**-The amount of oxygen gas (O_2) dissolved in water. Is reported in milligrams per liter (mg/l) of O_2 .

GLOSSARY (CONTINUED)

DIVERSITY-A measure of variation in and among species population of an area or community. Usually measured as a diversity index which is a ratio between the number of species and number (biomass, productivity) of individuals.

EQUITABILITY-One of the two major components of diversity (the other being species richness) which is a measure of the apportionment of individuals among the species. Computed in this study as a ratio between the number of species in a sample and the number expected from a community which conforms to MacArthur's (1957) broken stick model.

EVAPOTRANSPIRATION-Loss of water from the soil both by evaporation and by transpiration from the plants growing therein.

FAUNA-The animals or animal life of a region, period or environment. Usually used in reference to some particular group of animals rather than animal life in general.

FLORIDAN AQUIFER-This aquifer which consists of a thick series of marine limestone, is the major source of groundwater in Florida and is generally under artesian conditions.

FOSSORIAL-Adapted to digging. Used in reference to animals which live underground in burrows.

GYP SUM STACK-An outdoor pile of de-watered by-product gypsum.

HERPTILE-A reptile or amphibian.

HYDROGEOLOGY-A science dealing with the properties, distribution, and circulation of water in the soil and underlying rocks.

LEAKAGE COEFFICIENT or LEAKANCE-The ratio of the vertical hydraulic conductivity (permeability) to the thickness of a confining bed. The product of the leakage coefficient and the hydraulic head difference across the confining bed yields the recharge rate per unit area to the underlying aquifer.

MACROINVERTEBRATES-Invertebrate animals large enough to be seen with the unaided eye. Used in this study to refer to the various insects, crustaceans and worms living in aquatic habitats.

MACROPHYTES-Large plants. Usually used in reference to aquatic species distinct from algae, plankton and other simple plant forms.

GLOSSARY (CONTINUED)

- MATRIX**-The Gangue material in which the phosphate ore deposits are contained.
- NONPROCESS WATER**-Any water which does not come into incidental contact with any raw material, intermediate product, finished product, by-product, or waste product.
- NUTRIENTS**-Nitrogen and phosphorus compounds such as nitrate (NO_3), nitrite (NO_2), orthophosphate (PO_4), and total phosphorus as (PO_4) are nutrients which can stimulate the growth of algae in a stream.
- PERIPHYTON**-The assemblage of microorganisms attached to and growing upon solid surfaces. While primarily consisting of algae, they also include bacteria, fungi, protozoa, rotifers and other small organisms.
- PERMEABILITY**-A measure of the ability of a rock or soil to transmit fluid such as water. The hydraulic conductivity of a medium.
- PHYSIOGRAPHY**-The study of the surface features of the land.
- PIEZOMETRIC LEVEL**-The elevation to which the water from a given aquifer will rise in a standpipe under its full hydraulic head.
- PLANKTON**-The community of suspended, floating or weakly swimming organisms that live in the open water of lakes, rivers or streams.
- PROCESS WATER**-Any water which, during manufacturing or processing, comes into contact with or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product.
- PROGENY (RADON)**-The first four decay products of radon-222 have half lives of less than thirty minutes. These daughters or decay products are termed the progeny of radon.
- SEMI-AQUATIC**-Air-breathing species which tolerate water, and depend on aquatic systems for food or some other requirement.
- SOIL ASSOCIATION**-A group of soils that occur together in nature to form a distinctive landscape. A soil association consists of one or more major soils and at least one minor soil series.
- SPECIFIC CONDUCTANCE**-A measure of the ability of water to conduct electrical current. Gives a general indication of the total dissolved solids.

GLOSSARY (CONTINUED)

STANDARD PENETRATION TEST-This test consists of driving a standard size tube or "spoon" into the soil at the bottom of the bore hole using a 140-pound hammer falling freely for thirty inches. The number of blows of the hammer required to drive the tube a distance of 1-foot into the soil is termed the standard penetration resistance. Soil samples for classification and testing are obtained from the driven "spoon".

STORAGE COEFFICIENT-The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit charges in head.

STRATIGRAPHY-The branch of geology that deals with the definition and interpretation of the stratified rocks, the conditions of their formation, their character, arrangement, sequence, age, distribution, and their correlation by the use of fossils and other means.

SUBSTRATES-The substance or base on which an organism lives. Used here to indicate the stream or lake bed and any submerged structure such as a plant or tree limb on which aquatic organisms may grow.

SURFICIAL AQUIFER-A geologic formation at ground surface that transmits groundwater in sufficient quantity to supply wells or springs. A non-artesian surficial aquifer is one which contains water which is not confined and whose upper water surface (water table) is free to rise and fall.

SURGE POND-A water pond used to provide retention time (for monitoring for nonprocess water prior to discharge from the plant boundaries.

TRANSMISSIVITY-The rate at which water is transmitting through a unit width of the aquifer under a unit hydraulic gradient.

TURBIDITY-Measure of colloidal particles suspended in the water.

VERTEBRATE-That group of animals having a segmented spinal column or, in more primitive forms, a noto chord. The vertebrates include mammals, birds, reptiles, amphibians and fishes.

WETLAND-Areas which are saturated or innundated frequently and/or in prolonged periods and which have a vegetation composition dominated by water tolerant or hydrophytic species.

ABBREVIATIONS

Av. - Average
BACT - Best Available Control Technology
BPL - Bone Phosphate of Lime
CLR - Clarification
DAP - Diammonium Phosphate
DPY - Days per Year
F - Fluoride
GPM - Gallons (U.S.) per Minute
GTSP - Granular Triplesuperphosphate
GYP - Gypsum
H₂SO₄ - Sulfuric Acid
Lb. or Lbs. - Pound or Pounds
MGD - Millions of Gallons per Day
MG/L - Milligrams per Liter
MPA - Merchant Phosphoric Acid
MTPY - Metric Tons per Year (2,205 lbs)
OXY - Occidental Petroleum Corporation
P - Phosphoric
P₂O₅ - Phosphoric Acid
pCi/l - Picocuries per Liter
PF - Pollyphos
ppm - Parts per Million (by weight)
SA - Sulfuric Acid
SCM - Swift Creek Mine
SPA - Superphosphoric Acid
SPF - Speciality Phosphate Fertilizers
SCCC - Swift Creek Chemical Complex
SRCC - Suwannee River Chemical Complex
SRM - Suwannee River Mine
STPH - Short Tons per Hour (2,000 Pounds)
STPY - Short Tons per Year (2,000 Pounds)
S-X - Solvent Extraction
' - Foot
" - Inches

1.0 DESCRIPTION OF THE PROPOSED NEW SOURCE

1.1 OVERVIEW

The applicant, Occidental Chemical Company (Occidental) is a member of the Agricultural Products Group of the Hooker Chemical Corporation, a subsidiary of Occidental Petroleum Corporation.

The Florida operation of Occidental, located in Hamilton County, north of White Springs, Florida, is one of many fertilizer grade phosphate rock processing complexes in the State of Florida.

Occidental desires to increase the capacity of its North Florida Complex. This development will provide fertilizer-grade phosphates by upgrading phosphate rock and concentrating to high analysis liquid phosphate known as superphosphoric acid (SPA).

The expansion is planned for a site adjacent to the existing Swift Creek Mine located five miles west of the Suwannee River Chemical Complex.

The facility will require approximately 50 acres for plant and 275 acres each for a cooling pond and by-product gypsum storage, and will further involve small acreage for utilities and transportation rights-of-way. The project is located mainly in Section 36, Township 1 North, Range 14 East.

The superphosphoric acid product (SPA) will be shipped and become part of a balanced fertilizer produced near the user. In return, the SPA will

be traded for natural gas products -- ammonia and urea -- and potash in connection with a Global Agreement with the U.S.S.R.

To satisfy the agreement, facilities will be constructed in two phases. Each will produce approximately half the SPA required.

Phase I (as an "existing source"), is currently in construction at the Suwannee River Chemical Complex and will be complete in late 1978. This phase provides for diversion of part of the existing phosphoric acid capacity from granular fertilizers to SPA.

Needed facilities include phosphoric acid clarification and evaporators to remove water and concentrate to SPA.

Phase II (as a "new source"), is proposed for the Swift Creek mine site and is planned for completion in late 1979. This phase provides for manufacture of sulfuric acid and combination with phosphate rock to produce phosphoric acid.

Needed facilities will also include phosphoric acid clarification and evaporators to remove water and concentrate to SPA.

The Phase II expansion addressed herein is expected to result in the trade of approximately 0.5 million metric tons per year SPA for 0.75 million metric tons per year of ammonia, 0.5 million metric tons per year of urea, and 0.5 million metric tons per year of potash. The overall energy trade is favorable to the United States.

1.2 SUMMARY OF EXISTING FACILITIES

Occidental is the only company presently mining and processing phosphate in northern Florida. The operation which began in 1964 is situated on reserves encompassing an area of approximately 144,000 acres. There are two phosphate rock plants and one chemical complex: the Swift Creek Mine, the Suwannee River Mine and the Suwannee River Chemical Complex.

The Suwannee River Mine started in 1964; Swift Creek Mine in December, 1975. Each mine has the capacity to produce about 2.5 million tons of phosphate rock concentrate per year.

The mining and recovery of phosphate is a process of removing phosphate ore (matrix) from the ground by draglines and transporting it hydraulically to the beneficiation plants where the clays (approximately 23 percent) and sand (approximately 57 percent) are screened and removed. The remaining (approximately 20 percent) phosphate concentrate is stored aboveground and graded according to the quality of the material.

Florida law requires reclamation of mined lands. Approximately 6000 acres have been mined by Occidental since 1964 and the majority of the land is in use as water storage, cooling ponds, clay settling and plant sites. The remainder of the land has been, or is in the process of being, reclaimed.

The existing Suwannee River Chemical Complex started in 1966 and was expanded in 1975. This operation uses approximately two-thirds of the Suwannee River Mine production for the chemical upgrading of the rock into products for agriculture, chiefly high-analysis fertilizers. The chemical processing is necessary to convert the phosphate into a form that is available to plant life.

Wet phosphate rock is carried to the Suwannee River Chemical Complex by conveyor and reacted with sulfuric acid, filtered to remove a calcium sulfate (gypsum) by-product, and evaporated to form a concentrated phosphoric acid. This material is sold as a "merchant grade" liquid fertilizer or further processed to a granular, high-analysis fertilizer called triplesuperphosphate (TSP). Another granular product is produced by the reaction of ammonia with the phosphoric acid and granulated to form diammonium phosphate (DAP). A third granular product is produced by a process that calcines phosphate rock into a form suitable for use as an animal feed supplement.

A facility currently in construction provides for diversion of part of the existing phosphoric acid capacity from the above products to SPA. Thus, equipment for acid clarification, concentration, storage and loading of SPA will be complete in late 1978.

The facilities now employ approximately 1100 people. The plants operate on a twenty-four hour, seven-day-a-week schedule to ship products to domestic and overseas customers.

1.3 SUMMARY OF NEW SOURCE (PHASE II)

The new facilities will be capable of producing and shipping 500,000 metric tons per year of SPA. The SPA will contain 68-70 percent P_2O_5 (i.e. 350,000 metric tons per year of P_2O_5), with 25-40 percent conversion of total P_2O_5 to polyphosphates. This product will be used to produce stable solutions of balanced liquid fertilizers near the user.

Process units and related facilities will include:

- conveying of wet phosphate rock between existing mine and new processing plant,
- manufacture of sulfuric acid and combination with phosphate rock to produce phosphoric acid,
- clarification of phosphoric acid,
- evaporation of phosphoric acid to SPA, and
- storage, loading and shipping of SPA.

This complex will produce up to 4,000 short tons per day of sulfuric acid as an intermediate product in the production of 1,400 short tons per day of P_2O_5 as SPA.

By-product steam from the burning of sulfur to produce sulfuric acid will be used to generate 60 percent of the electric power to run the complex.

By-product gypsum will be stored in an impoundment serving a dual purpose as an evaporative cooling pond.

The development will be self-contained for sewage treatment, fire protection, potable water, storm drainage and garbage disposal.

Process water will be contained in a pond system designed, constructed, and operated to maintain a surge capacity equal to the run-off from the 25-year, 24-hour rainfall event. When chronic or catastrophic precipitation cause the water level to equal or exceed the midpoint of the surge capacity, process waters will be treated at a neutralization station to meet U.S. Environmental Protection Agency guidelines, 40 CFR, Section 418.15(c). Nonprocess waters, with rainfall run-off, will meet 40 CFR, 418.15(d).

1.4 SWIFT CREEK CHEMICAL COMPLEX PROPOSED FACILITIES--

PHASE II EXPANSION

1.4.1 ALTERNATE 1: DIHYDRATE WET PROCESS PHOSPHORIC ACID PLANT Phase II of the Russian SPA project engineering is scheduled to start April 1, 1978; start of construction is scheduled for August 1978; and plant startup is scheduled for October 1979.

Location of the proposed Swift Creek Chemical Complex (SCCC) is in Hamilton County in North Florida on a level plot of about 50 acres, north of White Springs, Florida, east of U.S. Highway 41 between White Springs and Jasper, Florida, as shown on Figure 1.4-1 Area Location Map. UTM coordinates are 320,860 E, 3,369,750 N.

1.4.1.1 Chemical Plant Description

1.4.1.1.1 Products

Final products shipped from the proposed SCCC will consist of 70 percent P_2O_5 superphosphoric acid (SPA). SPA will be shipped by rail car.

1.4.1.1.2 Capacity

Total production at the complex will be 500,000 metric tons per year of SPA containing 350,000 metric tons of P_2O_5 . Sufficient sulfuric acid will be produced on-site to satisfy requirements. Phosphate rock will be supplied from the existing Swift Creek Mine (SCM).

1.4.1.1.3 Raw Materials

Sulfur will be supplied by rail car, limestone, and lime by truck, and phosphate rock by conveyor belt.

1.4.1.1.4 Process Units

Intermediates and final products will be processed or produced on-site using the proposed facilities which consist of a phosphate rock transport system, one wet process phosphoric acid plant, phosphoric acid evaporation facilities, two contact sulfuric acid plants, a phosphoric acid clarification plant. and two SPA plants.

1.4.1.1.5 Auxiliary & Support Facilities

Support facilities at the proposed SCCC will consist of administrative offices, a central laboratory, a maintenance shop, a supplies warehouse, product storage and shipping facilities, one gypsum stack with associated cooling pond, fuel oil and miscellaneous chemicals storage, electric power substations, electric power generation (60 percent generated using excess process steam), roads, railroads, deep freshwater well, domestic sewage treatment plant, compressed air, interconnecting piping (for raw materials, intermediates, products).

The development will be self-contained for sewage treatment, fire protection, potable water, storm drainage, garbage disposal and electric power.

1.4.1.1.6 Water Balance

The proposed SCCC will have one 7,000 GPM freshwater well at a depth of about 800 feet.

One 500 GPM potable well at a depth of about 300 feet will supply all potable water uses. Treated domestic wastewater is discharged to the Swift Creek Mine water circuit.

Detail water balances were prepared for each process unit and support facility of the proposed Swift Creek Chemical Complex (Phase II Expansion) at full operation. Occidental Chemical Company's project scope; product slate and tonnages; material balances; process unit operating sequences; raw material, intermediate, and product specifications; performance requirements of air pollution control equipment; sketches of proposed gypsum stacks and cooling ponds; local weather data; and other information was used to develop the detail water balances which are included in the description of each unit or support facility.

An overall water balance is summarized in Figure 1.4-2 and Table 1.4-1 for the Swift Creek Chemical Complex (Phase II) in terms of MGD (millions of gallons of water per day). Figure 1.4-3 and Table 1.4-2 present the same data as GPM (gallons per minute). All are based on an operating time of 310 DPY (days per year).

Freshwater requirements are 3.76 MGD (2,611 GPM) and nonprocess water discharge is 1.65 MGD (1,142 GPM). The gypsum stack and cooling pond shows a deficit water balance of 0.23 MGD (158 GPM).

1.4.1.1.7 Water Discharges

The water discharge route is shown in Figure 1.4-4 and is the actual route to be used. Average daily flow (exclusive of rainfall run-off) is 1.40 MGD for 365 days per year.

Nonprocess water will discharge (with rainfall run-off) will flow north from the proposed chemical complex site in a fresh water ditch through a nonprocess surge pond of 30 acres. Then it will discharge to the freshwater ditch to Section 10 Pond for final clarification before discharge to Swift Creek at NPDES sampling point 001.

A treated process water discharge is not expected unless excessive rainfall occurs. If discharged, process water would be treated in a two-stage neutralization system using limestone and lime with intermediate settling. Discharge of treated water would then flow from the east end of the settling pond to intercept the fresh water ditch or to the Swift Creek Mine water circuit.

Actual flows at existing sampling point 001 for permit FL-0000655, located in Swift Creek, from January 1976 through September 1977 are shown in Figure 1.4-5. These flows include the SRCC, SRM and SCM discharges plus rainfall runoff. During this period, average flows (based on daily measurements) ranged from 4.0 MGD in May 1977 to 146 MGD in February 1978, with daily flows ranging from zero in May 1978 to 188.5 MGD in March and April 1976.

Nonprocess water will discharge to a fresh water ditch in the chemical plant, which discharges to a nonprocess surge pond, which discharges to

a second fresh water ditch, which discharges to the Section 10 pond, which discharges to Swift Creek. Prevention and control of contamination of nonprocess water will be accomplished in several ways.

First, all acid process and storage areas will be curbed, and separated from nonprocess waters and rain run-off areas. Acid leaks and spills will be collected and returned to the process or to the process water system.

Second, any point source nonprocess water that could become contaminated by leaks will be pH monitored in each process area on a routine basis and diverted from the fresh water ditch to the process water system until the leaks are repaired and the pH has returned to normal.

Third, nonprocess water that cannot become contaminated and rain run-off from nonprocess areas will go directly by way of the fresh water ditch to the nonprocess water surge pond. This nonprocess water surge pond will be 30 acres in size, 20 feet deep, and have a retention time of over 100 days except during rainfall periods. Inlet and outlet of the nonprocess water surge pond will be continuously pH recorded and alarmed for low pH levels to assume corrective action.

Fourth, if the pH leaving the nonprocess surge pond becomes too low, the discharge will be diverted to the second stage neutralization station, treated with lime, and settled in a pond.

Fifth, overflow from the settling pond will be discharged back to the second fresh water ditch going to the Section 10 pond for final clarification before discharging to Swift Creek. The Section 10 pond is 150 acres and 20 feet deep and has a retention time of 156 days, except during rainfall periods (based on nonprocess water discharge rate and Swift Creek Mine water discharge rate). This long retention time will allow clarification of the nonprocess and mine discharge water for removal of suspended solids and will dampen out any pH or contaminant changes should all of the first four control actions malfunction, which is highly unlikely.

1.4.1.1.8 Process Water Surge Levels

The proposed ponds are discussed in other sections of this report.

1.4.1.1.9 Permits

Eight Florida air construction permits have been issued for the proposed Phase II expansion at Swift Creek.

1.4.1.2 Description and Environmental Aspects of Proposed Process Units at Swift Creek Chemical Complex

1.4.1.2.1 Sulfuric Acid Plants E&F

Type of Plant: Two sulfur-burning double absorption contact sulfuric acid plants producing 98 percent sulfuric acid, complete with water treatment, cooling tower, oil fired startup heater, an auxiliary boiler and process steam turbine to generate electric power.

Product Capacity: Nominal capacity of 2,000 short tons per day each, 100 percent sulfuric acid basis; auxiliary boiler, 125,000 lb/hr-850 psig, 850°F; fuel will be 0.8 percent sulfur commercial distillate; operation 25 percent of the time.

Raw Materials: Molten sulfur, water, and air.

Storages: (1) 28,000 tons (100 percent basis) 98 percent acid storage in tanks plus one 2,500 ton (100 percent basis) 93 percent H_2SO_4 storage tank; (2) 10,000 tons molten sulfur in storage tanks; and (3) one fuel oil tank with capacity of 9,000 gal.

Air Emissions: Both sulfuric acid plants and auxiliary boilers have Florida DER construction permits issued February 28, 1978. Allowable air emissions according to EPA for plants E&F are 4 lb SO_2 /ton H_2SO_4 produced (100 percent basis) and 0.15 lb sulfuric acid mist/ton H_2SO_4 produced (100 percent basis). Auxiliary boiler No. 3 has no visible emission.

Water Discharges: Only nonprocess water is regularly discharged from the plant. Boiler blowdown, cooling tower blowdown, miscellaneous cooling water (consisting of cooling water for bearings, air compressors, air conditioners, and oil lubrication systems), condensate from the sulfur melting coils and rainfall run-off are discharged to the fresh-water ditch. Water from regeneration of the boiler feed water softeners

is discharged to the Swift Creek Mine water circuit adjacent to the proposed Swift Creek Chemical Complex. Table 1.4-3 summarizes water uses and discharges.

1.4.1.2.2 Phosphate Rock Transport No. 3 (Supplies Phosphoric Acid Plant D)

Type of Plant: A conveyor belt from the Swift Creek Mine will be used to handle wet rock to the plant and will discharge to a storage bin at phosphoric acid plant D.

Capacity: One conveyor belt which has a 280 short tons per hour capacity.

Raw Materials: Wet unground 66/69 BPL phosphate rock.

Storages: A 2-hour storage bin for wet rock storage.

Air Emissions: Air emissions will not occur in the conveying and storage of wet phosphate rock; therefore, particulate collection devices and air permits will not be required.

1.4.1.2.3 Phosphoric Acid Plant D

Type of Plant: Wet Process Dihydrate Phosphoric Acid Plant with one filter, and tank farm.

Capacity: Nominal capacity 1,400 short tons per day P_2O_5 .

Raw Materials: Wet unground 68 BPL phosphate rock and 98 percent Sulfuric Acid.

Storages: Two storage tanks for phosphoric acid storage at 28 percent P_2O_5 and 40 percent P_2O_5 with total volume of 800,000 gal.

Air Emissions: Phosphoric Acid Plant D has a Florida DER construction permit issued February 28, 1978. The allowable EPA and Florida air emissions are: Fluorides at 0.02 lb/ton P_2O_5 input (EPA & Florida) and particulates at 44.8 lb/hr (Florida).

Water Discharges: Only nonprocess water, rainfall run-off and filter skirt sprays are discharged. Process water is recirculated from the gypsum stack and pond, except when treatment of excess water is required. Nonprocess water consisting of vacuum pumps seal water, filter skirt sprays, and miscellaneous cooling water consisting of cooling water for air compressors, oil coolers, and air conditioners is discharged to the sulfuric acid plants cooling tower for makeup water. Table 1.4-4 summarizes water uses and discharges.

1.4.1.2.4 27 Percent-54 Percent Phosphoric Acid Evaporation

Type of Plant: Forced-circulation type steam heated wet process phosphoric acid evaporators.

Capacity: Nominal capacity 1,400 short tons per day P_2O_5 from 27 percent to 54 percent P_2O_5 .

Raw Materials: Wet process phosphoric acid.

Storages: Storage tanks with a capacity of 2,700,000 gal. acid.

Air Emissions: No air emissions. Total condenser system used and control equipment not required.

Water Discharges: Process water is recirculated from gypsum stack and cooling Pond. Nonprocess water from vacuum pump seals and compressor cooling is discharged to the sulfuric acid plants cooling tower for make-up water. Table 1.4-5 summarizes water uses and discharges.

1.4.1.2.5 Phosphoric Acid Clarification

Type of Plant: Occidental proprietary process for removal of impurities from wet process phosphoric acid.

Capacity: Nominal capacity of 1,400 short tons per day P_2O_5 .

Raw Materials: Wet process phosphoric acid.

Storages: Incorporated into clarification plant design.

Air Emissions: The phosphoric acid clarification plant has Florida DER construction permit issued February 28, 1978. The allowable air emission according to the State of Florida are: Fluorides BACT --0.05 lb F/ton P_2O_5 input = 3.02 lb/hr and particulate at 7.72 lb/hr.

Water Discharges: Only nonprocess water is regularly discharged. Process water is recirculated from gypsum stack and cooling ponds, except when treatment of excess water is required. Nonprocess water from vacuum pump seals and miscellaneous water (cooling water for air compressors and oil cooling), and rainfall run-off is discharged to the freshwater ditch. Table 1.4-6 summarizes water uses and discharges.

1.4.1.2.6 Superphosphoric Acid Plants C&D

Type of Plant: Forced circulation type steam heated superphosphoric acid evaporators, product storage, and tank car cleaning station.

Capacity: Nominal capacity 1,400 short tons per day P_2O_5 .

Raw Materials: Clarified wet process phosphoric acid.

Storages: Two tanks with a total storage capacity of 12,000 metric tons of acid.

Air Emissions: Superphosphoric acid evaporators C&D have Florida DER construction permits issued February 28, 1978. The allowable EPA air emission is 0.01 lb F/equivalent ton P_2O_5 feed.

Water Discharges: Process water is recirculated from the gypsum stack and cooling ponds. Nonprocess water from vacuum pump seal water is discharged to the sulfuric acid plants cooling towers as make-up water. Rainfall run-off reports to the fresh water ditch. Tables 1.4-7 and 8 summarize water uses and discharges.

1.4.1.3 Description of Environmental Aspects of Auxiliary and Support Facilities--SCCC

1.4.1.3.1 Gypsum Stack and Cooling Pond

Function: To store by-product waste gypsum and provide cooling for process water recirculated to the process units.

Size: The gypsum, cooling and surge ponds have a total area for rainfall of 550 to 600 acres and total wet area for solar evaporation of 240 acres.

Capacity: Handles phosphoric acid Plant D, 28 percent-54 percent P_2O_5 evaporation, clarification, superphosphoric acid plants C&D, and SPA storage and shipping.

Water Recirculation: Can vary from 44,000 to 58,000 GPM depending on demand.

Process Water Discharge & Treatment: The proposed SCCC will generate nonprocess water (with rainfall run-off) and, infrequently, treated process water.

Process Water Treatment Requirements: The gypsum stack and cooling pond facility has a negative water balance of 158 GPM on an annual average basis; however, seasonal imbalances of excess rainfall over evaporation during a portion of the year may require infrequent treatment and discharge of treated process water. Based on the New Source Effluent Guidelines, the facility must be designed, constructed and operated to maintain a surge capacity equal to the run-off from the 25-year, 24-hour rainfall event. The proposed surge capacity will be one-half times greater.

automatically operated bag dust collector (not shown) which discharges collected dust back to the silo. A feeder underneath the CaCO_3 silo will feed dry limestone to the slurry tank where it will be wetted and slurried with water leaving the clarifier/thickener overflow. Instrumentation will maintain a constant slurry density and level in the slurry tank. Limestone slurry will be pumped through a recirculation line routed over Reactor 1 and Reactor 2 and a pH controlled flow sent to each reactor to maintain pre-set pH levels. pH will be recorded and alarms provided to indicate improper pH levels.

Process water at a flow controlled and recorded rate of 2000 GPM will be fed to Reactor 1 where it will be reacted with a slurry of finely ground limestone. The partially neutralized water from Reactor 1 will overflow to Reactor 2, react with additional limestone slurry to pH 3.0, and then overflow to the clarifier/thickener. Some settled sludge will be recycled by a pump from the bottom of the clarifier/thickener to Reactor 1. All sludge generated by the neutralization will be pumped to the gypsum stacking area and the flow recorded. Clear overflow from the clarifier-thickener will be pumped to lime treatment and the flow recorded.

(2) Stage 1 Lime Neutralization to pH 5.5 -- Following partial neutralization to pH 3.0 with limestone followed by clarification, the process water will be neutralized with lime to pH 5.5 and clarified to complete Stage 1 neutralization. A preliminary PID* is shown in Figure 1.4-10 for the proposed Stage 1 lime neutralization and process flows are shown in Table 1.4-16.

* Process and Instrumentation Diagram (PID)

Dry ground lime (CaO) will be pneumatically unloaded by truck to the CaO silo equipped with high and low level alarms. Also provided will be an automatically operated bag dust collector (not shown) which discharges collected dust back to the silo. A feeder underneath the CaO silo will feed dry lime to the slakers where the lime is slaked (reacted) with water from the Stage 2 Pond to produce a slurry of calcium hydroxide. Instrumentation will maintain a constant slurry density and level in the slurry tank located underneath the slakers. Lime slurry will be pumped through a recirculation line routed over the Stage 1 Reactor and a pH controlled flow sent to Reactor 1 to control the pH at 5.0.

Partially neutralized process water at pH 3.0, from the limestone neutralization of Stage 1, will be fed at a flow controlled and recorded rate to Reactor 1 and will overflow or be pumped to the Stage 1 Pond at a pH of 5.0. Nonprocess water may also be fed to the Stage 1 Reactor for neutralization should it become contaminated.

(3) Stage 2 Lime Treatment to pH 9.0 -- Figure 1.4-10 is a preliminary PID for the proposed Stage 2 lime neutralization. Process flows are shown in Table 1.4-16.

Partially neutralized and clarified process water from the Stage 1 Pond will be fed to the Stage 2 Reactor at a flow controlled rate which will be recorded. Lime slurry from the recirculation line will be fed at a controlled rate to automatically keep the pH in the Stage 2 Reactor

at pH 9.0. Overflow from the Stage 2 Reactor will be pumped to the Stage 2 Pond for clarification and clarified effluent will be discharged to the second fresh water ditch going to the Section 10 Pond as previously described in the Summary.

Water Balance: Detail process water requirement calculations based on planned operation shows a deficit water balance of 158 GPM, 310 days per year operating time.

1.4.1.3.2 Nonprocess Water Discharge

There is one chemical plant well with a capacity of 7000 GPM.

The average well water consumption will range from 2,511 GPM to 2611 GPM, 310 days per year depending upon operations. Resulting nonprocess water discharged to the fresh water ditch will vary from an average of 1042 GPM to 1142 GPM, 310 days per year. The difference between well water use and nonprocess water discharge is due to evaporation in cooling towers, chemical water consumption, steam, stack water, and water entering the process water systems.

1.4.1.3.3 Domestic water Treatment Plants

Function: Plant serves office, lab, shops, phosphoric acid Plant D, sulfuric acid plants E&F, 28 percent-54 percent P_2O_5 evaporation, clarification, superphosphoric acid plant C&D, SPA storage and shipping.

Size: 25,000 gallon design with chlorine contact chamber.

Capacity: 25,000 CPD and the population served is 180.

Water Balance: Water is discharged to Swift Creek Mine water system. Water uses discharge is summarized in Table 1.4-17.

Permits: A Florida DER construction permit is pending for 90 percent treatment or better.

Domestic Water Treatment: Extended aeration process followed by chlorination. The allowable effluent limitation in Florida is: 90 percent treatment or better. A Florida DER construction permit application is pending.

Fresh Water Supply: The proposed well for the Chemical Plant is No. C-4 with a pumping capacity of 7000 GPM and a depth of approximately 800 ft. The casing for the well is unknown at this time.

A deep well analysis of existing Swift Creek Mine well No. SC-1 is shown in Table 1.4-18. This is a 7000 GPM well with 800 ft casing depth. It is expected that the well water analysis for the proposed SCCC will be similar.

1.4.1.3.4 Process Chemicals

The process chemicals for the sulfuric acid plant boiler and cooling tower and given in Table 1.4-19.

The total defoamer use is budgeted at 700 metric tons per year and is used in Phosphoric Acid Plant D, 27 percent-54 percent evaporation, clarification, and the SPA plants for foam prevention. A water-soluble defoamer is used and ends up in the SPA acid, and the process water circuit. No discharge occurs to the nonprocess water system.

Total inorganic chemicals used are budgeted at 13,000 metric tons per year and leave the plant site as a by-product. No discharge occurs to the nonprocess water system.

Limestone use is budgeted at 6268 metric tons per year and will leave the plant site as a by-product. Lime is budgeted at 643 metric tons per year and will be used to treat nonprocess water when it becomes contaminated.

LIST OF REFERENCES
(SECTION 1.4)

Florida, State of, Department of Environmental Regulation (FDER), Eight
FDER Construction Permits Issued 2/28/78.

OXY/SPA Project Scope Addendum.

Suwannee River Chemical Complex, aerial photographs of plant site--
scale 1" = 333'.

Table 1.4-1 Water Summary (Based on 310 DPY Operating Time) - MGD-
Proposed Swift Creek Chemical Complex-Overall Balance
on Complete Complex

	MGD	
	In	Out
Well Water	3.76	
Rainfall	2.27	
Vent Air (Including Combustion Water)	0.03	
Water in Raw Materials	0.13	
Natural Evaporation		1.03
Process Evaporation		0.99
Deposited Water with Gypsum		0.53
Chemically Combined Water		0.25
Chemically Combined Water in H_2SO_4		0.17
Scrubber Stacks		0.04
Cooling Tower Evaporation		1.66
Water in Products & By-Products		0.04
Nonprocess Water ⁽¹⁾		1.65
Sanitary & Regeneration Water to Mine Water		0.06
Deficit: Gypsum Stack & Cooling Pond	0.23	
TOTAL OVERALL BALANCE ON COMPLETE COMPLEX:	6.42	6.42

(1) To fresh water ditch; see individual process units for description--excludes rainfall run-off.

Table 1.4-2 Water Summary (Based on 310 DPY Operating Time) -GPM-
Proposed Swift Creek Chemical Complex-Overall Balance
on Complete Complex

	In	GPM Out
Well Water	2,611	
Rainfall	1,577	
Vent Air (Including Combustion Water)	24	
Water in Raw Materials	87	
Natural Evaporation		713
Process Evaporation		687
Deposited Water with Gypsum		368
Chemically Combined Water		178
Chemically Combined Water in H_2SO_4		115
Scrubber Stacks		32
Cooling Tower Evaporation		1,152
Water in Products & By-Products		25
Nonprocess Water ⁽¹⁾		1,142
Sanitary & Regeneration Water to Mine Water		45
Deficit: Gypsum Stack & Cooling Pond	158	
TOTAL OVERALL BALANCE ON COMPLETE COMPLEX:	4,457	4,457

(1) To freshwater ditch; see individual process units for description--
excludes rainfall run-off.

Table 1.4-3 Water Summary (Adjusted to 310 DPY Operation to Conform with Phosphate Units) - Proposed Swift Creek Chemical Complex - Sulfuric Acid Plants E and F

	In	GPM	Out
Fresh Water	727		
Nonprocess Water to Cooling Tower	1,365 ⁽¹⁾		
Condensate Return	637 ⁽²⁾		
Steam			712 ⁽³⁾
Demineralizer			13 ⁽⁴⁾
Cooling Tower Evaporation & Drift			1,152
Nonprocess Water ⁽⁵⁾			732
Water in H ₂ SO ₄ - Free - to P ₂ O ₅ Plant			12
Water in H ₂ SO ₄ - Free - to Sales			6
Water in H ₂ SO ₄ - Chemical			115
Vent Air	13		
TOTAL SULFURIC ACID PLANTS E & F	2,742		2,742

- (1) From vacuum pump seals and miscellaneous cooling water
- (2) Returned from phosphoric acid evaporators
- (3) Net export steam
- (4) To mine water circuit
- (5) Cooling tower and boiler blowdown, cooling water, sulfur melting condensate; to fresh water ditch--excludes rainfall run-off

Table 1.4-4 Water Summary (Based on 310 DPY Operating Time)-Proposed
Swift Creek Chemical Complex-Phosphoric Acid
Plant D -Dihydrate Process

	In	GPM Out
REACTION & FILTRATION:		
Steam	70	
Cold Pond H ₂ O	12,576	
Phosphate Rock	79	
98% H ₂ SO ₄ (Free Water)	12	
Fresh Water	909	
27% P ₂ O ₅ Acid (Free Water)		447
Warm Pond Water to Pond		12,070
Condensate (Filter Wash)	20	
Chemically Combined H ₂ O ⁽¹⁾		208
Nonprocess Water ⁽²⁾		40
Seal & Cooling Water to H ₂ SO ₄ Cooling Tower		820
Vent Air	6	
Condensate Return to H ₂ SO ₄ Boilers		70
Stack		17
TOTAL REACTION & FILTRATION	13,672	13,672

(1) Gypsum Cake Hydration Water

(2) Filter Skirt Sprays using Well Water (non-contact water) to
freshwater ditch--excludes rainfall run-off.

Table 1.4-5 Water Summary (Based on 310 DPY Operating Time)-Proposed
Swift Creek Chemical Complex-27% to 54% P_2O_5 Evaporation

	In	GPM	Out
Steam	502		
Cold Pond Water	14,270		
Feed Acid	447		
Vent Air	1		
54% P_2O_5 Acid			54
Warm Pond Water		14,735	
Seal & Cooling Water to H_2SO_4 Cooling Tower			330
Condensate to H_2SO_4 Boilers			457
Stacks			3
Fresh Water	351		
TOTAL 27%-54% P_2O_5 EVAPORATION	15,579		15,579

Note: No nonprocess water discharge--excludes rainfall run-off

Table 1.4-6 Water Summary (Based on 310 DPY Operating Time)-Proposed
Swift Creek Chemical Complex- Clarification

	In	GPM Out
Steam	10	
Cold Pond H ₂ O	2,995	
Phosphoric Acid Feed	109	
Fresh Water	330	
Phosphoric Acid Product		117
Warm Pond Water to Pond		2,983
Nonprocess Water ⁽¹⁾		330
By-Products		16
Vent Air	4	
Stack		12
TOTAL CLARIFICATION	3,448	3,448

(1) To Fresh Water Ditch; vacuum pump seal water, air compressor cooling, and oil cooling--excludes rainfall run-off

Table 1.4-7 Water Summary (Based on 310 DPY Operating Time)-Proposed
Swift Creek Chemical Complex-Superphosphoric Acid
Plants C & D

	In	GPM	Out
Steam	160		
Cold Pond Water	14,256		
54% P_2O_5 Acid	54		
70% P_2O_5 Acid			(30)(1)
Warm Pond Water		14,340	
Seal Water to H_2SO_4 Cooling Tower		200	
Condensate to H_2SO_4		127	
Flashed Steam		33	
Fresh Water	200		
TOTAL SUPERPHOSPHORIC ACID PLANTS A & B	14,670		14,670

(1) () denotes negative; chemical water removed. Balance
excludes nonprocess water from rainfall run-off

Table 1.4-8 Water Summary (Based on 310 DPY Operating Time)-Proposed
Swift Creek Chemical Complex-SPA Storage & Shipping

	In	GPM Out
Steam	3	
Fresh Water	5	
Product		3
Condensate to H ₂ SO ₄ Plant		3
Pond Water	3	5
TOTAL SPA STORAGE & SHIPPING	11	11

Note: Balance excludes rainfall run-off

Table 1.4-9 Allowable Effluent Limitations-Treated Process Water

	Existing Daily Av. MG/L	EPA Guidelines Daily Max. MG/L	Proposed Daily Av. MG/L	EPA Permit* Daily Max. MG/L
TSS**	50	150	50	150
Total Phosphorus (as P)	35	105	35	105
Fluoride	25	75	25	75
Ra-226	--	--	9 pCi/L	9 pCi/L
pH			Will be established upon final settlement of guidelines.	

* Proposed by EPA on 4/28/78 for existing discharges at SRCC

** Waived if chemically treated and settled to meet other
limitations

Table 1.4-10 Process Water Expected Analysis--Swift
Creek Chemical Complex

Analysis ⁽¹⁾	<u>8/20/77</u>	<u>12/8/77</u>
pH, Std. Units	1.65	1.70
Total Acidity, as CaCO ₃	34,385	32,800
Mineral Acidity, as CaCO ₃	20,976	--
Fluoride, as F	6,500	6,600
Total Phosphorus, as P	4,290	3,960
Total Suspended Solids	35	69
Total Dissolved Solids	26,250	25,952
Sulfate, as SO ₄	5,700	5,200
Chloride, as Cl	45	72
Conductivity, as umhos	24,000	--
Sodium, as Na	1,094	896
Calcium, as Ca	500	77
Silicon, as Si	1,406	1,294
Aluminum, as Al	389	409
Iron, as Fe	263	204
Magnesium, as Mg	44	76
Lead, as Pb	--	<0.1
Manganese, as Mn	--	7.88
Radium-226 ⁽²⁾	23.8 - 24.8 pCi/l	

(1) All values expressed as MG/L unless otherwise noted

(2) Table 3.5-3 Summary Report

**Table 1.4-11 Allowable Effluent Limitations--Treated Contaminated
Nonprocess Water**

	Existing Daily Av. MG/L	EPA Guidelines Daily Max. MG/L	Proposed Daily Av. MG/L	EPA Permit* Daily Max. MG/L
TSS	--	--	50	150
Total Phosphorus (as P)	35	105	35	105
Fluoride	25	75	25	75
Ra-226	--	--	9 pCi/L	9 pCi/L
pH	--	--	Will be established upon final settlement of guidelines.	

Table 1.4-12 Effluent Quality Produced by Two-Stage Limestone-Lime Treatment

Analysis ⁽¹⁾	Process Water	Stage II Supernatant
pH, Std. Units	1.70	9.0
Acidity, as CaCO ₃	32,800	---
Fluoride, as F	6,600	12-20
Total P	4,000	1-13
Total Suspended Solids	69	15
Chlorides, as Cl	72	75
Sulfates, as SO ₄	6,200	2,709
Sodium as Na	896	900
Calcium, as Ca	77	375
Magnesium, as Mg	44	22
Aluminum, as Al	389	<0.2
Chrome, as Cr	0.43	<0.10
Zinc, as Zn	1.46	<0.10
Iron, as Fe	263	0.10
Manganese, as Mn	7.9	0.03
Boron, as B	0.90	0.50
Lead, as Pb	<0.10	<0.10

(1) All values in MG/L unless otherwise noted

Table 1.4-13 Chemical Requirements and Solids Production--
Two Stage Limestone-Lime Treatment (Swift
Creek Chemical Complex

	CHEMICAL REQUIRED ⁽¹⁾		Solids Production	
	<u>lb/1000 gal</u>	<u>TONS/DAY⁽²⁾</u>	<u>lb/1000 gals⁽³⁾</u>	<u>acre-ft/day⁽⁴⁾</u>
Calcium Carbonate	125	180	83.3	0.17
Stage 1 Lime	86.1	124	182	1.0
Stage 2 Lime	17.4	25	60.5	1.1

1. As delivered, commercial grade CaCO_3 and CaO
2. Based on 2000 GPM treatment rate
3. Dry solids basis
4. Lagoon storage volume based on 2000 GPM treatment rate and ultimate solids concentrations (BY WT.) OF 40% SOLIDS FOR calcium carbonate sludge, 20% for Stage 1 sludge, and 6% for Stage 2 sludge.

Table 1.4-14 Calcium Carbonate Treatment Process Flows--
Swift Creek Chemical Complex

<u>Stream No.</u>	<u>Designation</u>	<u>Flow GPM</u>	<u>pH</u>	<u>lb/min Solids</u>	<u>Ton/day Solids</u>	<u>% F</u>	<u>% P</u>
1	CaCO ₃ Feed	--	---	250	180	--	--
2	Process Water	2000	1.5	---	---	0.66	0.43
3	CaCO ₃ Slurry	27	--	83	60	---	---
4	CaCO ₃ Slurry	54	--	167	120	---	---
5	Reactor 2 Feed	2082	2.0	---	---	---	---
6	Thickener Feed	2136	3.0	334	240	---	---
7	Recycle Sludge	55	3.0	167	120	---	---
8	Waste Sludge	55	3.0	167	120	---	---
9	Slurry Water	70	3.0	---	---	0.30	0.43
10	Supernatant	1956	3.0	---	---	0.30	0.43

Table 1.4-15 Instrumentation Legend

<u>Symbol</u>	<u>General Description</u>
LT	Level Transmitter
LC	Level-based Controller
LAH	High Level Alarm
LAL	Low Level Alarm
DT	Density Transmitter
pHT	pH Probe and Transmitter
pHIR	pH Indicator, Recorder
pHC	pH-Based Controller
pHA	pH-Alarm, High and/or Low
FET	Flow Meter, Transmitter
FIR	Flow Indicator, Recorder
FI	Flow Indicator
FRC	Flow Ratio-Based Controller
DC	Density-Based Controller

Table 1.4-16 Lime Treatment System Process Flows--Swift Creek Chemical Complex

Stream No.	Designation	Flow GPM	pH	Lb/min Solids	Ton/Day Solids	mg/l F	mg/l P
1	CaO Feeder	---	--	206	148	---	---
2	Paste $\text{Ca}(\text{OH})_2$	---	--	245	176	---	---
3	CaCO_3 Sup'n't	1956	3.0	---	---	3000	4300
4	Lime Slurry	229	--	204	147	---	---
5	Lime Slurry	46	--	41	29	---	---
6	Reacted Stage 1	2185	5.5	364	262	---	---
7	Stage 1 Sup'n't	2185	5.5	---	---	50-80	---
8	Reacted Stage 2	2231	9.0	121	87	---	---
9	Stage 2 Sup'n't	1966	9.0	---	---	25	35
10	Slurry Water	265	9.0	---	---	25	35
11	Non-Process Water	Alternative Treat Both Stages with Lime					
12	Non-Process Water	Alternative Treat Second Stage Only					
13	Non-Process Water	1142 - Normally Suitable for Direct Discharge					

Table 1.4-17 Water Summary (Based on 310 DPY Operating Time)-
Swift Creek Chemical Complex-General Facilities

	In	GPM Out
Fresh Water	81	
Rainfall into Process Areas	3	
Sanitary Water to Mine Circuit		16
Rainfall to Ponds		3
Nonprocess Water ⁽¹⁾		65
TOTAL GENERAL FACILITIES	84	84

(1) To fresh water ditch--excludes rainfall run-off

Table 1.4-18 Swift Creek Mine- Deep Well Water Analyses
(Not used as potable water)

CERTIFICATE OF ANALYSIS*		
Laboratory Marks	Deep Well No. SC-1	
pH	6.4	
Color	15	
Odor	Indefinite	
Alkalinity	41	ppm
Total Hardness as CaCO_3	157	ppm
Total Solids	322	ppm
Total Volatile Solids	82	ppm
Fixed Solids	240	ppm
Nitrate Nitrogen ($\text{NO}_3\text{-N}$)	0.12	ppm
Sulfate (SO_4)	127	ppm
Hydrogen Sulfide	0.36	ppm
Chloride (Cl)	18	ppm
Fluoride (F)	1.6	ppm
Calcium (Ca)	62	ppm
Magnesium (Mg)	0.20	ppm
Iron (Fe)	0.60	ppm
Sodium (Na)	8.5	ppm
Potassium (K)	1.9	ppm
Non-Carbonated Hardness as CaCO_3	115	ppm
Silica (SiO_2)	34	ppm
Sodium Chloride (NaCl)	30	ppm

* Thornton Laboratories, Tampa, Florida, March 30, 1976

Table 1.4-19 Process Chemicals-Sulfuric Acid Plant Boiler and Cooling Tower Chemicals (at Rated Capacities)

Water Treatment Chemicals ⁽¹⁾			
Unit	Material	Sulfuric Acid Plants E & F	Description
Boiler	Liqui-Treat	187	Organic & Inorganic Chetland
"	NA-5	12	Neutralizing Amine
"	Corrogen	36	Catalyzed Sodium Sulfite
Cooling	Betz 430 or 431	112	L.W. Polymer and Phosphonate Dispersant
"	Slimicide J-12	42	Non-Oxidizing Biocide
"	Chlorine	21	Chlorine

EFFLUENT LOADINGS ⁽¹⁾			
Chemical	Sulfuric Acid Plants E & F lbs/day	Concentration Increase in Non-Process Water ⁽²⁾	
Sulfate & Sulfide as SO ₄	2,467	179	MG/L
Chloride as Cl	139	10.1	MG/L
Calcium as CaCO ₃	1,646	120	MG/L
Magnesium as CaCO ₃	623	453	MG/L
Silica as SiO ₂	275	20	MG/L
Total Phosphate as PO ₄	43	3.1	MG/L
Total Copper as Cu	0.15	10.9	µGM/L
Total Iron as Fe	3.7	0.28	MG/L
Soluble Zinc as Zn	0.25	18.2	µGM/L

(1) Betz Laboratories, Inc. to Occidental Chemical, 12/23/77 for SRCC, adjusted for SCC plants capacity

(2) Based on Fresh Water Ditch Flow of 1.65 MGD--excludes rainfall run-off

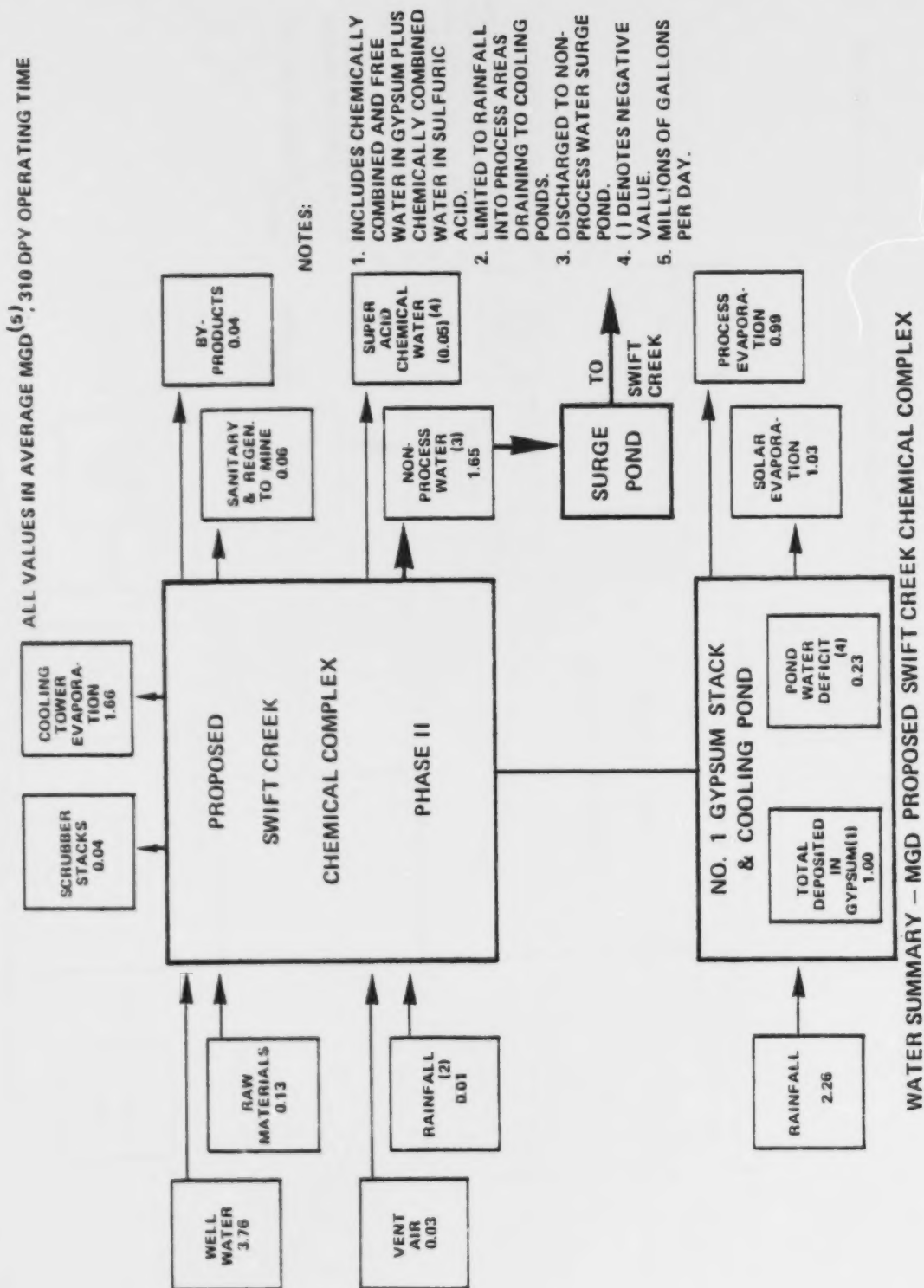


FIGURE 1.4-2

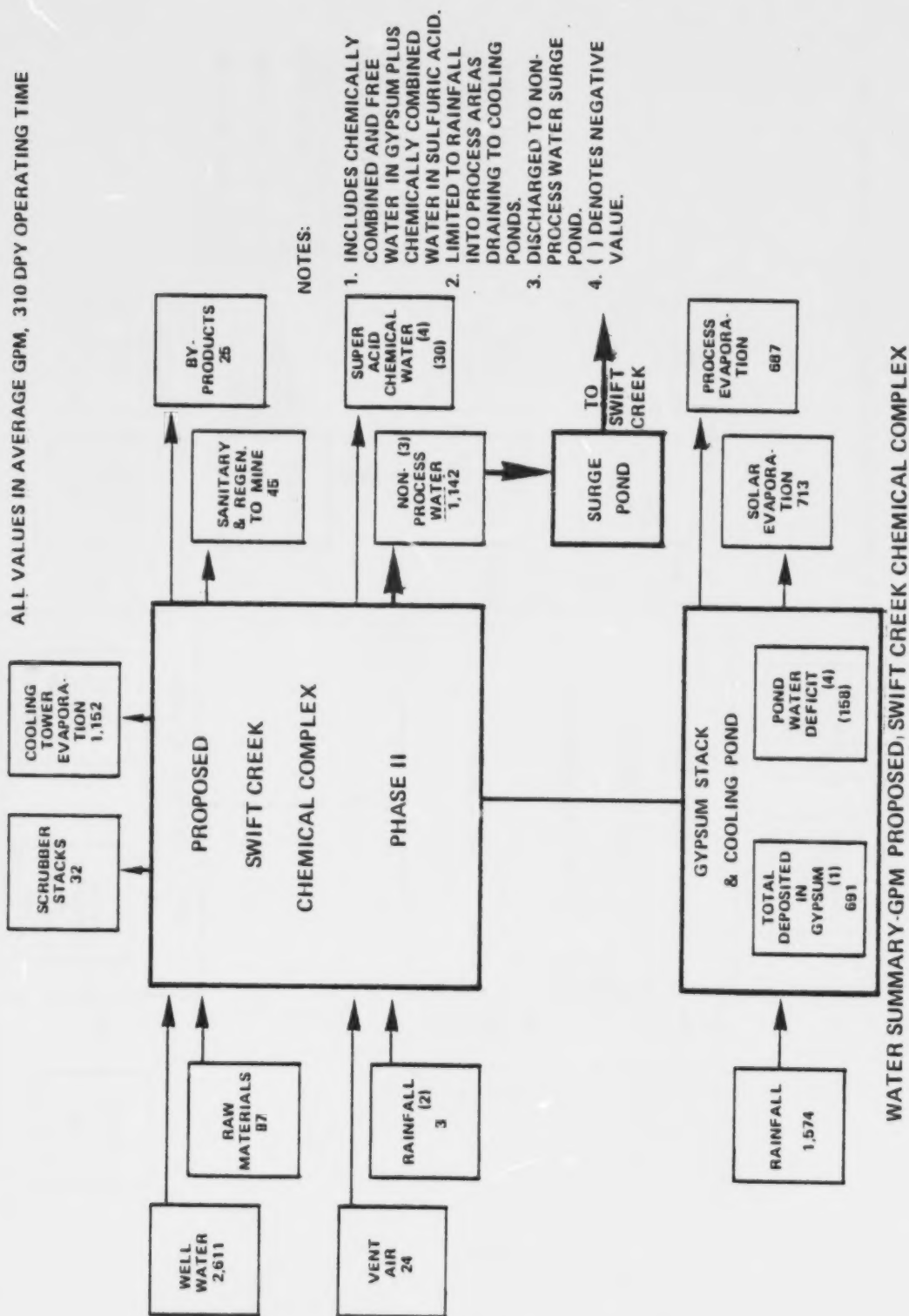


FIGURE 1.4-3

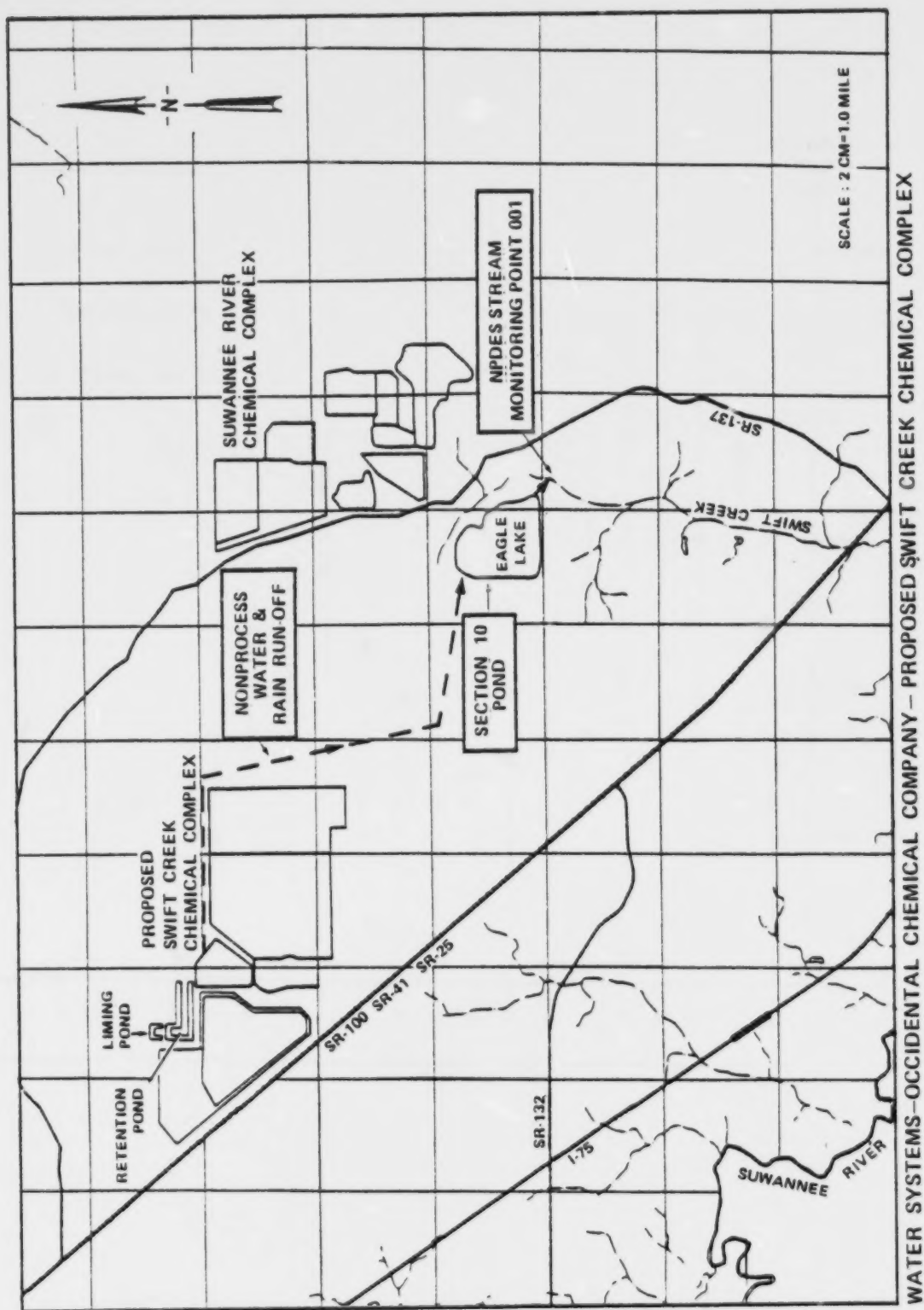
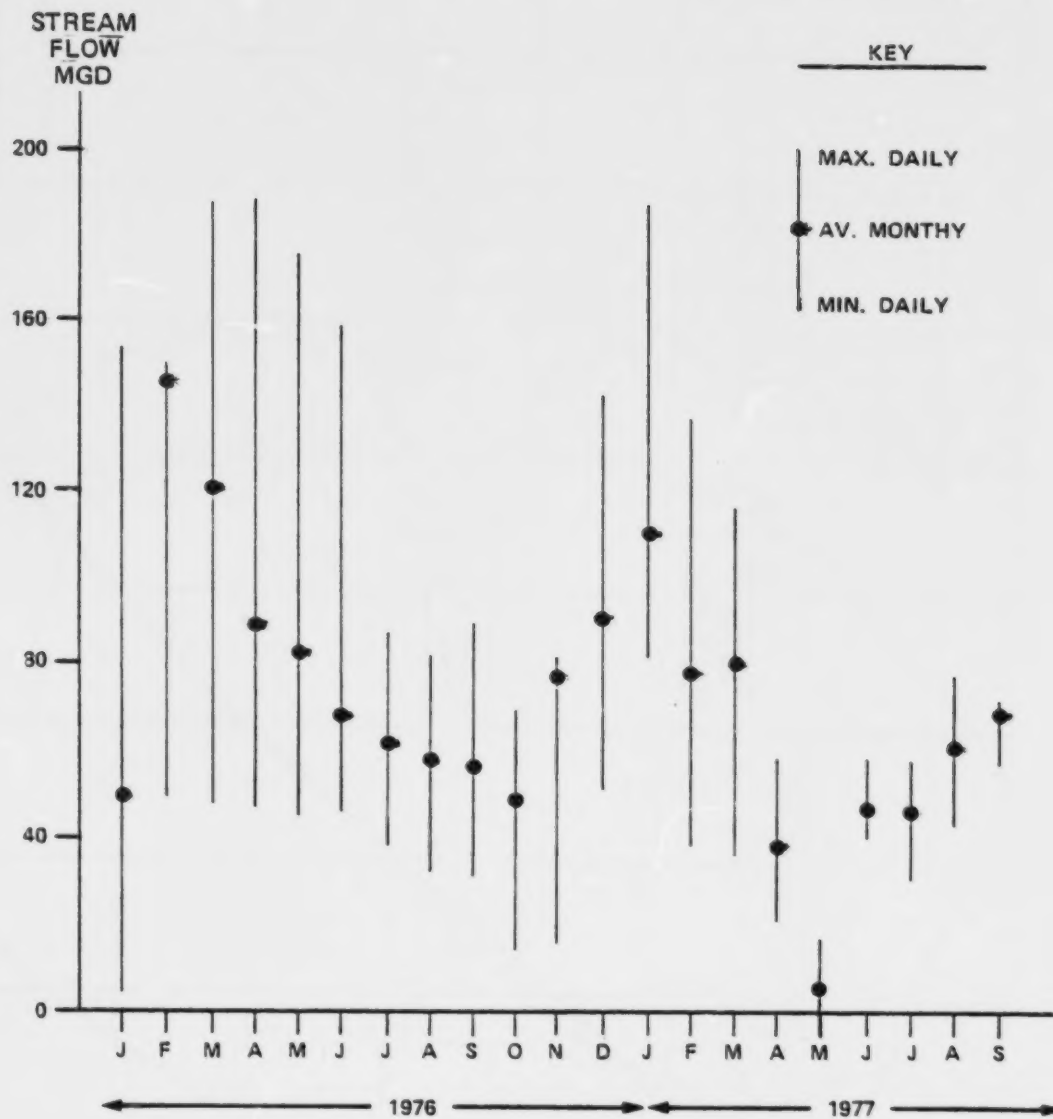
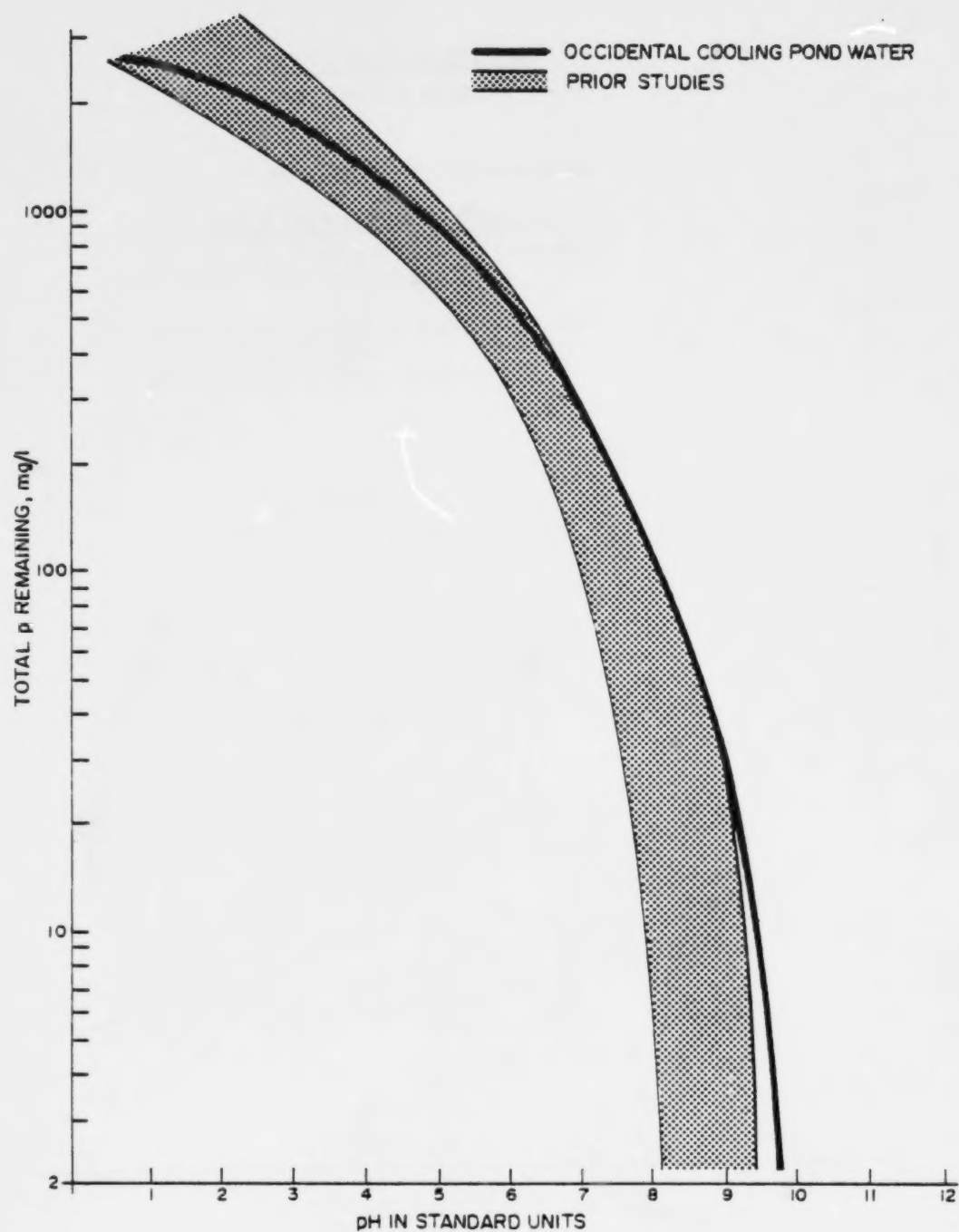


FIGURE 1.4.4



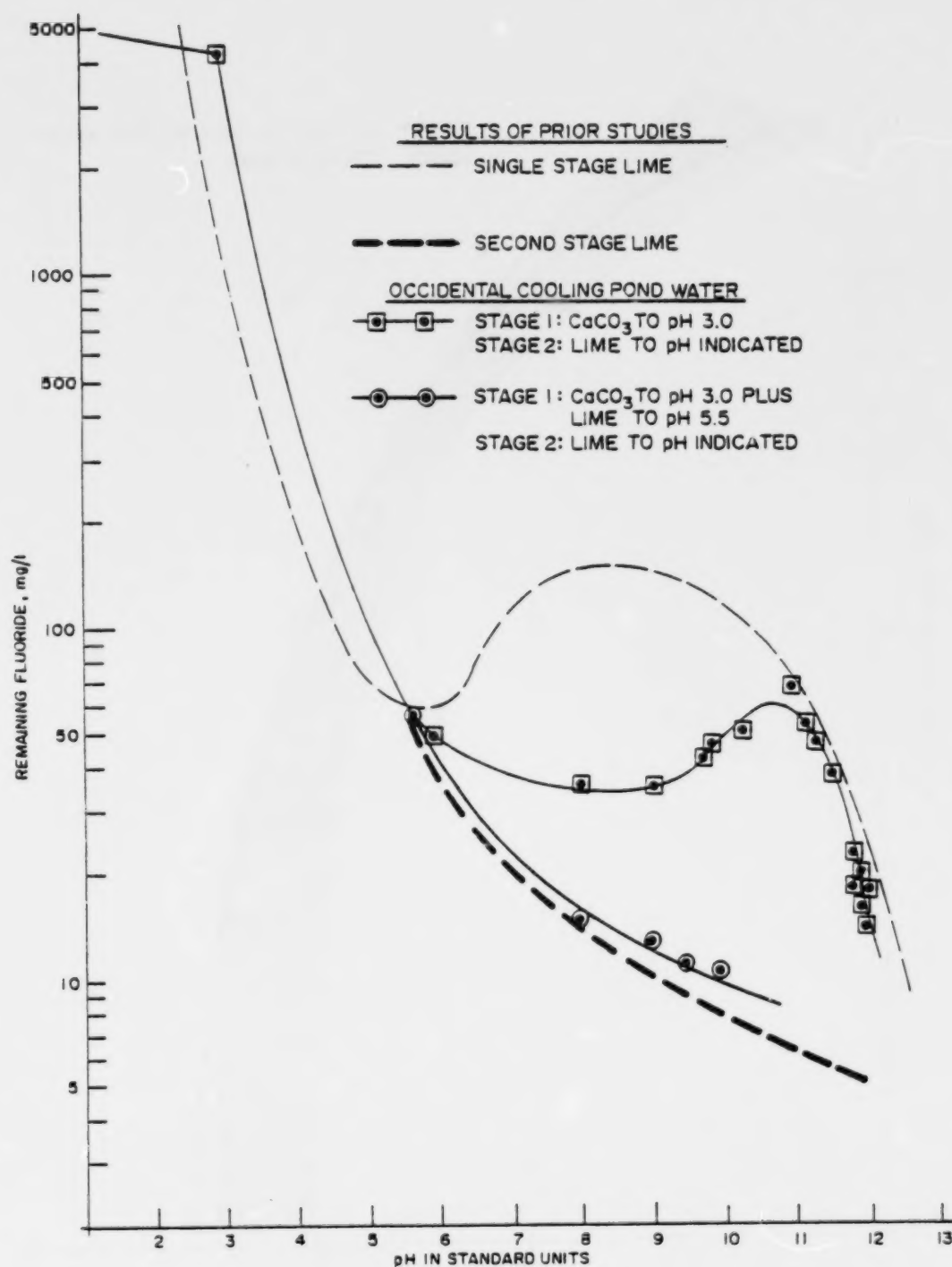
STREAM FLOW, MGD AT STREAM MONITORING POINT 001

FIGURE 1.4-5



EFFECT OF pH ON REMAINING PHOSPHORUS.

FIGURE 1.4-6



EFFECT OF FINAL pH ON REMAINING FLUORIDE

FIGURE 1.4-7

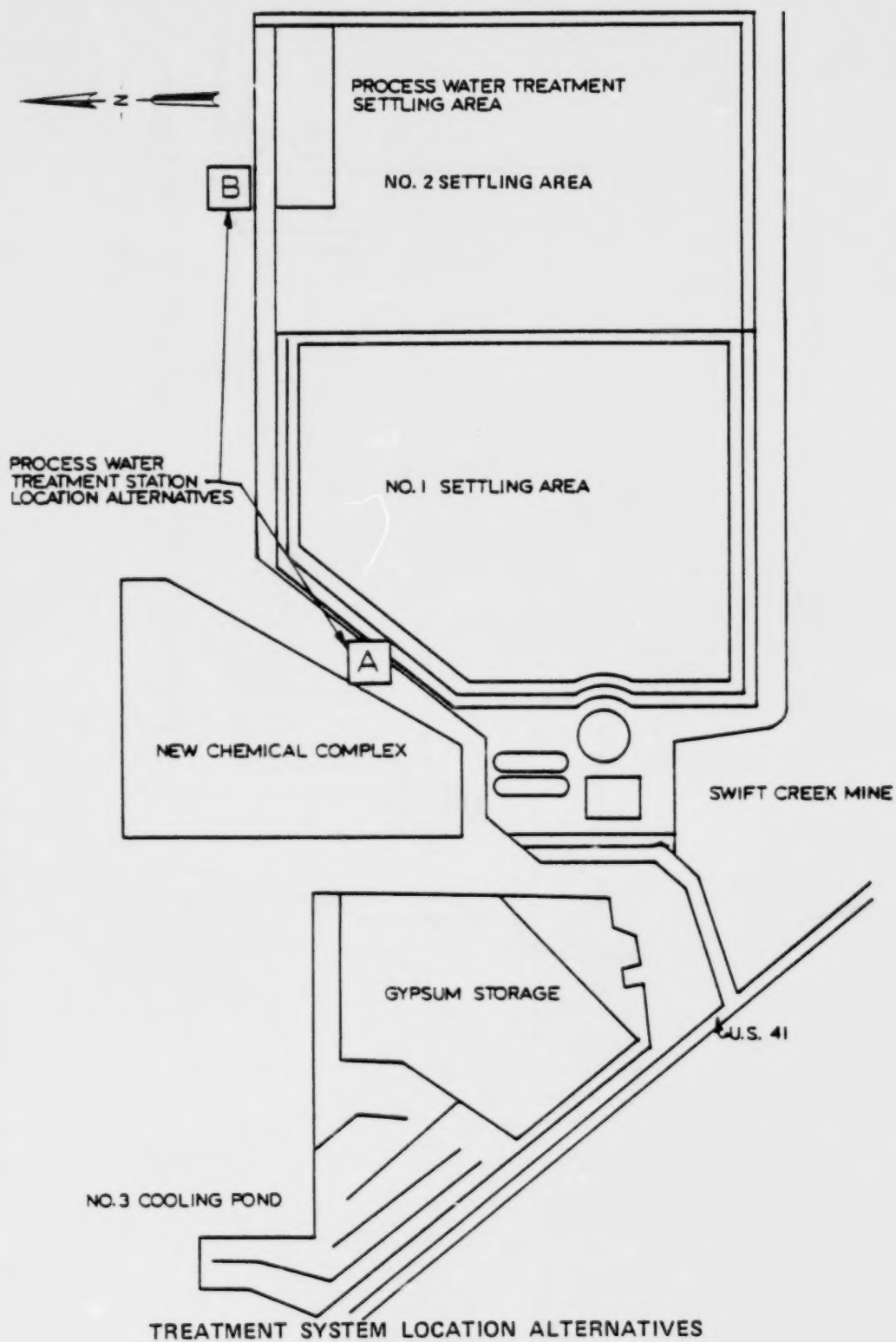
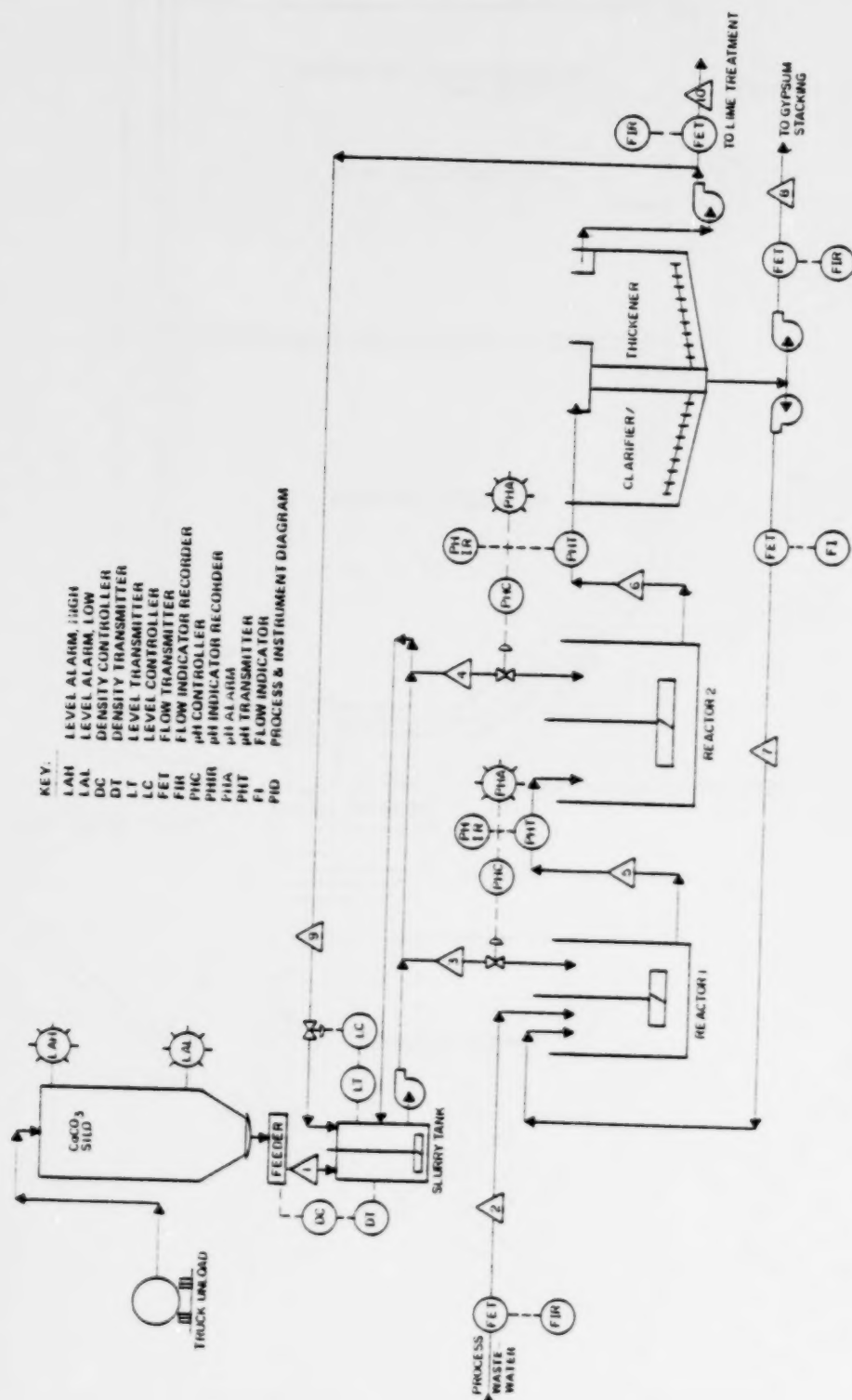


FIGURE 1.4-8



CALCIUM CARBONATE TREATMENT SYSTEM PRELIMINARY PID-OCCIDENTAL SWIFT CREEK COMPLEX

FIGURE 1.4.9

APPENDIX A1.1
DESCRIPTION OF PROPOSED FACILITIES

A1.1 EXISTING SUWANNEE RIVER MINE AND BENEFICIATION PLANT
PLUS PHASE I MODIFICATIONS

A1.1.1 INTRODUCTION

A1.1.1.1 Index

A1.1 EXISTING SUWANNEE RIVER MINE (SRM) AND BENEFICIATION
PLANT PLUS PHASE I MODIFICATIONS

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A1.1.1.4 Abbreviations & Definitions

Av. - Average

BACT - Best Available Control Technology

BPL - Bone Phosphate of Lime

DPY - Days per Year

F - Fluoride

GPM - Gallons (U.S.) per Minute

Lb. or Lbs. - Pound or Pounds

Matrix - Phosphate ore which includes product, clays, and tailings

MGD - Millions of Gallons per Day

MG/l - Milligrams per Liter

MTPY - Metric tons per year (2,205 lbs.)

Overburden - Top Soil above the phosphate deposit

OXY - Occidental Petroleum Corporation

P₂O₅ - Phosphoric Acid

pCi/l - Picocuries per Liter

ppm - Parts per Million (by wt.)

SCM - Swift Creek Mine

SPA - Superphoric Acid

SRCC - Suwannee River Chemical Complex

SRM - Suwannee River Mine

STPH - Short Tons per Hour (2,000 lbs.)

STPY - Short Tons per Year (2,000 lbs.)

' - Feet

" - Inches

Tailings - Sand

A1.1.2 MINE DESCRIPTION

Operation of the Suwannee River Mine (SRM) began in August 1965 with one dragline and one recovery plant. In March 1967, the second dragline was added and the recovery plant was doubled in size. In January 1974, a third dragline was added. The washer capacity was increased, starting operations in March 1974.

With the addition of the third dragline and pumping system, it is possible to feed the plant with two mining and pumping systems at one time, while the third dragline is stripping a front. Figure A1.1-1 shows the general layout of the Suwannee River Mine.

For Phase 1 of the Russian SPA project, now under construction, a rock preparation section will be added. This will screen wet concentrate and remove particles larger than 28 mesh to prepare the feed to the Suwannee River Chemical Complex.

Location of the Suwannee River Mine is in Hamilton County in North Florida on a level plot about one mile from the Suwannee River Chemical Complex, surrounded by pine forests, north of White Springs, Florida, east of State Road 137 which intersects U.S. Highway 41 between White Springs and Jasper, Florida, as shown on Figure 1.4-1. UMT coordinates are E-328320 and N-336820.

A1.1.2.1 Products

Final products (concentrates) shipped from the mine will consist of wet and dry 68 percent BPL (31.12 percent P_2O_5) phosphate rock and dry 72 percent BPL (33 percent P_2O_5) phosphate rock. Practically all of the concentrate produced will be used in the Suwannee River Chemical Complex. Of this amount, 40 percent will be dried and the remainder will be used as wet rock containing approximately 15 percent water.

A small amount of dry rock is currently ground in a ball mill and transferred to a dry storage silo. This can be loaded to railroad cars or trucks for shipment. For Phase I, it is anticipated that these facilities will be operated intermittently, producing a very small tonnage.

The wet and dry concentrate is transported by a conveyor belt about one mile to the Suwannee River Chemical Company. Alternate railroad and truck loading facilities are available.

A1.1.2.2 Capacity

Total production of phosphate rock concentrate will average about 2,500,000 short tons per year with about 40 percent produced as dry rock to eliminate phosphate rock drying. This reduces fuel consumption and reduces phosphate rock dryer particulate emissions about 40 percent below current levels.

A1.1.2.3 Ore Body

The land-pebble phosphate deposits consist of pebbles and fine phosphatic sand dispersed in nonphosphatic sandy clay. The phosphatic bearing ore (matrix) is covered by a quartz, sand, and clay mixture (overburden). The overburden averages 24-1/2 feet in thickness, generally ranging from 10 to 30 feet. The matrix averages 14-1/2 feet in thickness, ranging from 10 to 30 feet.

A1.1.2.4 Mining Facilities

Three draglines are used to mine and slurry the matrix. The overburden is first removed and stored in ridges on mined-out land. The matrix is then removed and slurried with water which is recycled from the pond area. The slurry, containing approximately 35 percent solids, is pumped to the beneficiation plant.

A1.1.2.5 Beneficiation Facilities

The matrix slurry is pumped to the matrix header box which is located above and feeds the trommel screens. Oversize material +5/8" to 1" can be routed to the mudball sump and pumped to the ponds. Alternately, this can be fed to hammermills and recycled to the matrix header.

The trommel screen underflow passes through a series of double-deck screens. Overflow from the top deck can be routed to the mudball system or to the rod mill storage bins for milling. The latter product (pebble rock), after milling, is conveyed to the wet rock product

(concentrate) storage area. The overflow from the second screen is passed through finishing pebble screens and the final product is conveyed to the wet concentrate storage area.

The double-deck screen underflow is passed through a series of desliming tanks and cyclones and the clays are removed as overflow slurry which is pumped to the clay pond.

Cyclone underflow is sized and passed through the coarse and fine flotation cells. In this operation the tailings (coarse sand with low phosphate content) are separated from the phosphate rock (concentrate). Kerosene, amines, fatty acids, and miscellaneous flotation agents are used for conditioning. Proper pH adjustment of the flotation water is accomplished with acid and/or base. Well water is used for make-up water in this circuit.

The tailings are removed as a slurry and pumped to the tailings pond area. Clear water overflow is recycled to the mine circuit. Currently the concentrate is dewatered in cyclones and stored in piles in the wet storage area. No storage building is required as the material is coarse and wet. From these piles the material is reclaimed and transferred to the Suwannee River Chemical Complex or to the dryer area.

For Phase I of the Russian project, new facilities will be added so that the concentrate slurry in the flotation plant can be screened

prior to dewatering and storage so that 100 percent will pass through a 28 mesh screen. Engineering was started in April 1977 with plans for start-up in October 1978.

This screening unit will be intergrated into the existing plant as a finishing section using existing transportation equipment to existing storage. The product, as dewatered fine and coarse fractions, will be transported to the existing outside pile storage with an existing conveying and stacking system.

The coarse fraction (oversize) will be dried and ground in existing facilities. All dried material will be transported in an existing conveyor system to the Suwannee River Chemical Complex. The same conveying system will be modified so that it can also transfer screened wet rock to the Suwannee River Chemical Complex for use as wet rock feed to two of the phosphoric acid plants.

A1.1.2.6 Pond Facilities

Effluent slurries from the washer and flotation plants are pumped to large ponds usually constructed on mined-out lands. Retaining walls (dikes) of these ponds are built in accordance with rules and regulations established by the State of Florida.

The clays and mudballs are pumped into settling ponds. Clear water effluent is recycled to the mine circuit. Excess clear water is discharged to Swift Creek at discharge point 001. In the clay ponds, the settled slurry contains about 23 percent solids. The settled solids in mudball ponds contain about 75 percent solids and those in the tailings ponds contain about 85 percent solids.

Since there is excess volume of water in the overall balance between solids removed as concentrate and water retained in the clays and mudball ponds, man made lakes are created. When mining and excavation of an area is completed, the land is reclaimed in accordance with the laws of the State of Florida. Some of the reclamation areas of the Suwannee River Chemical Complex are shown in Figure A1.1-1.

These lakes provide recreational facilities for boating and fishing. Reclaimed land can be used for agriculture, building, forestation, and recreational projects.

The tailings are generally used to build dikes as well as to provide fill for mined-out land. At the present time, they are being pumped in the mine pit south of SR-9 shown in Figure A1.1-2. The slurry water eventually is recycled to the mine pit or can be returned to the recycle stream entering the beneficiation plant.

A1.1.2.7 Dryer Facilities and Dry Phosphate Rock Grinding, Storage,
Shipping, and Transport

Concentrate is reclaimed from wet storage and dried in two fluid bed dryers, heated by natural gas or No. 2 fuel oil. The dried product is conveyed to dry rock storage silos. From the silos, the dried rock can be conveyed to the Suwannee River Chemical Complex or loaded into rail cars or trucks. A small amount is ground in a ball mill for shipment as ground rock by truck.

Cyclonic scrubbers are used to remove the particulate matter emitted in the dryer exit gas streams. A small amount of water is circulated around another cyclonic scrubber which removes the particulate matter from ventilation of the dry rock silos, reclaiming, and shipping facilities. In the water balances, the water used in the latter scrubber is included with that used in the dryer scrubber water.

A small amount of dry rock reclaimed from storage is ground in a ball mill and the dry rock is conveyed to storage. Product is loaded into trucks for shipment. The silo, reclaiming and loading vent air, is passed through a Mikro-Pulsaire bag collection which removes over 99.8 percent of the entrained particulate solids.

The amount of ground rock shipped in Phase I of the Russian project will be small and operations will be intermittent.

A1.1.2.8 Support Facilities

Support facilities at the Suwannee River Mine consist of administrative offices, laboratory, maintenance shop, mobile shop, mines trailers, fuel oil storage, miscellaneous chemical and reagent storage, electric power substations, roads, railroads, freshwater wells, potable water, domestic sewage systems, compressed air, and two small boilers and settling areas.

A1.1.2.9 Mine Water Balance

The Suwannee River Mine has two 7,000 GPM freshwater wells at depths of 804 ft and 1265 ft and one 1,700 GPM well at 700 ft. The two 7,000 GPM wells are operated in the dry season.

Three potable wells, 200 GPM, 60 GPM, and 60 GPM, at depths of 201 ft, 140 ft, and 240 ft, supply all potable water uses. Treated domestic water is discharged to the Suwannee River Mine water circuit.

Detail water balances were prepared for each mine operation and support facility (Tables A1.1-1 and A1.1-2) of the existing Suwannee River Mine plus Phase I expansion to reflect planned operations when Phase I of the Russian SPA project is in full operation. Occidental Chemical Company's project scope; product slate and tonnages; material balances; process unit operating sequences; raw material, intermediate, and product specifications; performance tests of air pollution control equipment; plant reports; aerial photographs of mine ponds (to scale); local weather

data; and other information was used to develop the detail water balances which are included in the description of each unit or support facility.

An overall water balance is summarized in Figure A1.1-3 for the Suwannee River Mine plus Phase I in terms of MGD (millions of gallons of water per day) and as MGD and GPM. All are based on an operating time of 365 DPY (days per year).

Freshwater requirements are 10.15 MGD (7,051 GPM) and mine discharge water is 8.40 MGD (5,835 GPM).

In the Suwannee River Mine operation, water is used to transport the matrix to the beneficiation plant. In this plant, clays, mudballs, and tailings are removed as slurries and settled in ponds. A small amount of water is used in the dryer area scrubbers, which water is also settled in these ponds. Well water make-up is required primarily for the flotation operation. The excess clear mine water overflow from the ponds is discharged. This flow ultimately discharges into Swift Creek. A flow of 100,000 GPM is recycled from the ponds' overflow in the mining circuit. Well water make-up is 7,051 GPM. Thus, 93.4 percent of this total flow is recycled water.

A1.1.2.10 Water Discharges

Water discharge routes are shown in Figure A1.1-2, which is a reproduction of an aerial photographs of the existing Suwannee River Mine and Suwannee River Chemical Complex facilities.

NPDES Discharge Point 001 is in Swift Creek, about 2.2 miles (3.7 km) south of the southwest corner of the Suwannee River Chemical Complex plant site.

Actual flows at EPA Discharge Point 001 for permit FL-0000655, located in Swift Creek, from January 1976 through September 1977, are shown in Figure 1.4-5. These flows include the Suwannee River Mine discharges plus the Suwannee River Chemical Complex and Swift Creek Mine and rainfall runoff; therefore, they cannot be correlated directly with past mines or chemical plant operation or future planned operation at the completion of Phase I. During this period, average flows (based on daily measurements) ranged from 4.0 MGD in May 1977 to 146 MGD in February 1976, with daily flows ranging from zero in May 1976 to 188.5 MGD in March and April 1976. This compares with average calculated Suwannee River Mine water discharge rates of 8.4 MGD. The average discharge rates of nonprocess water from the Suwannee River Chemical Complex is 7.06 MGD.

NPDES Discharge Point 002 is in Hunter Creek approximately one mile northeast of the northeast corner of Pond SR6B, 2-1/2 miles upstream of the Suwannee River.

Actual flows at EPA Discharge Point 002 for Permit 0000655 located in Hunter Creek, from January 1976 to September 1977, are shown in Figure A1.1-4. The maximum flow recorded in November 1976 shows a discharge

flow rate of 56.5 MGD. During the month of December 1976, no flow rates could be obtained as the area was flooded. During August of 1977, there was no discharge flow at this point. The average daily flow rate varied between 0.0 MGD on August 1977 and 31.0 in April 1977.

A1.1.2.11 Permits

The Suwannee River Mine has several water and air operating permits for the existing operation and several dredge and fill construction permits.

Water permits consist of one EPA NPDES permit and two Florida permits for domestic water treatment. Currently, EPA has proposed a revised NPDES permit and had a public hearing on February 9, 1978 in White Springs, Florida.

Air permits consist of four Florida operating permits for the existing operations. According to the test data, all emissions are lower than allowed by permits.

There are three dredge and fill permits from the State of Florida and one in administrative proceedings. In addition, there are two construction permits and three mine operating permits from the State of Florida.

A1.1.3 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF EXISTING FACILITIES PLUS

PHASE I EXPANSION--SUWANEE RIVER MINE

A1.1.3.1 Mining

Type of Mine: The Suwannee River Mine has 3 draglines. Two are 33 cubic year draglines, page Model 740 with 195 foot booms, and one is a 45 cubic year dragline, Page Model-752.

Capacity of Mine: The total annual capacity of the three draglines is rated at 35,800,000 cubic yards. An average of 13,840,000 (DRY) tons/year matrix is mined which is equivalent to a total of 33,285,000 cubic yards (as mined).

Ore Body Description: The phosphatic ore (matrix) is covered with a layer of sand and quartz (overburden). The overburden is removed and generally stacked in ridges on mined-out land. The overburden ranges from 10 to 30 feet in thickness averaging 24-1/2 feet. The matrix ranges from 5 to 25 feet, averaging 14-1/2 feet.

Ore Transport System: There are three pits in which the matrix is slurried and pumped to the beneficiation plant by use of three Type GIW 18" x 18" LSA 44 pit pumps. The slurry, containing approximately 35 percent solids, is pumped through a 20-in. line to the beneficiation plant as feed stock. Type GIW 18" x 18" SRT 40 GIW pumps are used as booster pumps, usually spaced 5,000 ft apart. Clear recycle overflow water from the ponds is pumped to the pits and used to slurry the matrix.

Air Emissions: Since this operation is a wet handling slurry system, there are no pollutant air emissions or regulations requiring permits in the mining and ore transport areas.

Water Discharge: Water is used to slurry and transport the matrix to the beneficiation plant and is recycled.

As previously mentioned, rain water on surrounding land area drains to Swift Creek or Hunter Creek, on which the NPDES Sample Points 001 and 002 are located. Groundwater enters the mine water recycle circuit by seepage into the mine cuts. The water balance for this area is shown in Table A1.1-3 as MGD and Table A1.1-4 as GPM.

Permits: Dredge and fill permits issued by the state of Florida are as follows: (1) Permit No. 24-31-0196-2E for temporary fill to move a dragline; (2) Permit No. 24-33-0524-2E for installation of a matrix slurry line; (3) Permit No. 24-10-0693-2E for constructing a road to move heavy equipment; and (4) One permit has been applied for to mine land in Section 8, Township 15, Range 16E, Hamilton County.

A1.1.3.2 Beneficiation Facilities, Feed Preparation (Phase I), and
Wet Phosphate Rock Storage and Reclaim

A1.1.3.2.1 Washer

Type of Plant: At the Suwannee River washer, the matrix is pumped into a common matrix header box located above the trommel screens. The

washer is divided into three trains referred to as the north, middle, and south washers. The north and middle washers are the older washers and are constituted as follows: Each washer has three trommel screens in parallel, two static screens with 14 mesh punched plate panels, one log washer, one 6' x 16' Hewett-Robbins double-deck screen with 1/4 in. woven wire screen panels on the top deck and 16 mesh woven wire screen panels on the bottom deck, and one 6' x 16' Hewett-Robbins finished pebble screen with 16 mesh woven wire screen panels.

The south washer is the March 1974 addition to the washer plant and it is divided into three trains, each train being constituted as follows: Trommel screen, static screen with 14 mesh punched plate screen panels, 6' x 16' Allis-Chalmers low-head primary matrix screen with 14 mesh isobar screen panels on the bottom deck, and 6' x 16' Allis-Chalmers low head finish pebble screen with 16 mesh isobar screen panels.

All of the above screen underflows go to either the north or south deslime tank by gravity flow from the upper levels, being pumped from the lower washer levels. The log washer overflow goes to a ground level sump where it is joined by floor wash-up and spills, and hammermill product when they are used on the mud balls, and all are pumped back to the matrix header box. The trommel screen oversize plus 5/8 in. to 1 in. goes to the mud ball sump. The overflow from the top deck of the double-deck screens, plus 1/4 in. material can

be routed either to the mudball disposal sump or to the rod mill storage bins. The overflow from the finish pebble screens can be routed either to the mud ball disposal system or to the rod mill storage bins. There is no pebble storage pile from which pebble can be reclaimed directly to the rod mill bins.

The Marcy rod mill product is pumped to the north deslime tank. Each of the two deslime tanks has three GIW 12 in. LSA 300 H.P. pumps which pump to fifteen 24 in. primary desliming cyclones located between the two 65 ft raw feed tanks also, each deslime tank has one 12" x 16" LSA 36 GIW pump with a 500 H.P. AC motor to pump to the 100-foot diameter storage tank through five 24 in. primary deslime cyclones. All of the primary desliming cyclone overflows go to the primary clay settling area which is mined-out pits to the northwest of the plant.

Capacity: The washer will handle 15,320,000 tons (dry basis) of matrix a year. Approximately 35.0 percent of the material is clay which is removed and pumped to the clay ponds in which the solids settle, recycling clear overflow water in the mine circuit.

Air Emissions: Since the rock is processed in the wet state, there are no particulate emissions. No permits are required.

Water Discharges: All water used in the washer operation is mine recycle water. The matrix is pumped in as a 30-35 percent slurry.

Clear recycled mine water overflow from the ponds is used in the washer operations. Clays and mud balls are pumped to ponds as a slurry. The clear overflow from the settling pond areas is the mine recycle water.

Water Balance: A water balance of the beneficiation plant is shown in Table A1.1-5 as MGD and Table A1.1-6 as GPM. The washer is an area in the beneficiation plant.

A1.1.3.2.2 Flotation Plant

Type of Plant: The underflow slurry from the final desliming cyclones is first treated in the sizing plant. The sizing is done by two separate sizing plants--one unit for each of the two flotation plants.

The No.1 sizer consists of two Hartman-Fabco hydraulic sizers, which are fed raw feed from the No. 1 raw feed tank by means of three PMCO 12 AMA pumps or from one GIW 12" x 12" LSA 32 pump from the 100 foot raw feed bin. The two sizers split the raw feed into three portions, a plus 16 mesh portion which is pumped back to the washer, a minus 16 mesh plus 28 mesh portion which goes to the coarse feed tank, and a minus 28 mesh portion which goes to the coarse feed tank, and a minus 28 mesh portion which is distributed to three fine feed tanks. The fine feed distribution is controlled by means of hydraulically operated gates on the feed distribution box.

The No. 2 sizer consists of one Hartman-Fabco hydraulic sizer and three V-box elutriator sizers. These sizers are fed by two PMCO 12 AMA pumps from the No. 2 raw feed tank or from one GIW 12" x 12" LSA 32 pump from the 100-ft raw feed storage bin. The V-box sizers make two products--a coarse underflow and a fine overflow. The coarse underflow goes to isobar static screens where the plus 16 mesh is removed and pumped back to the washer and the minus 16 mesh plus 28 mesh material goes to the coarse feed tank. The minus 28 mesh plus 150 mesh material is distributed to three fine feed tanks.

The fine and coarse slurries from the sizing process are pumped to the flotation plant which is divided into three plants, each having some different equipment.

The No. 1 Plant, which was the first plant built and operated, starting in August of 1965, consists of three trains of two rougher cells each. Originally the feed was dewatered and controlled by a Dorr Rake Classifier on each train. These have now been replaced by two 24 in. cyclones fed by a PMCO 8 MO pump directly from the fine feed tanks. The rougher cells are 100 cu. ft. Dorr-Oliver built MS type cells having five agitators per bank of cells. The cells are fed from Dorr-Oliver conditioners with the aqueous base solution going into the lead conditioner and being controlled by pH, and the fatty acid mix and kerosene going into the second conditioner and controlled by flow rate set by the operator. From the second conditioner, the slurry flows to a satellite conditioner ahead of the cell. The No. 1

Plant also has one 300 cu ft Wemco cell which is fed from the coarse feed bin through a "live" tank or slurry bin, controlled by a pneumatic valve for density, to three 24 in. dewatering cyclones which then feed the three conditioners in series. The No. 1 Plant rougher concentrate is deoiled in gravity type deoil agitators, the acid flow being controlled by pH from a probe in the deoil cyclone overflow. The deoil cyclones are followed by two stages of wash boxes, using recycled water in the primary and deep well water in the secondary.

The amine cells are Dorr-Oliver MS type cells with six agitators--the amine and kerosene being controlled by flow rate from a loop line.

The No. 2 Plant consists of two trains of three rougher cells each. These cells are Denver DR cells with five agitator units per cell. These cells are fed by conditioners which get their dewatered feed from cyclones operated from slurry bins. The deoiling circuit is the same as the No. 1 Plant and the amine cells are also the same.

The coarse plant consists of four trains of two flotation belts each. These trains originally had Dorr Rake Classifiers which have also been replaced by dewatering cyclones fed directly from the coarse feed tanks. The cyclone underflow goes to rotary mixers and then to the flotation belts, which receive the same aqueous base solution and fatty acid and

kerosene from the same loop lines as the cells. Here the base solution is also controlled by flow rate and not by pH. The belt rougher concentrate is de-oiled in the same manner as the cells and goes to one six-agitator Dorr-Oliver flotation machine.

The three plants pump their respective concentrates to separate dewatering cyclones before going to the wet rock piles.

Tailings from the flotation plant which are essentially coarse sand with very low P_2O_5 content are pumped as a slurry to mined-out pits and are also used in building pond retaining walls. After settling, the clear water overflow is recycled in the mine circuit.

Capacity: The feed to the flotation plant is 9,890,000 tons/yr (dry basis). The wet rock production (concentrate) is 2,458,000 tons/yr. The difference of 7,632,000 tons/yr are tailings.

Air Emissions: There are no particulate emissions or regulations requiring permits as the material is handled as a slurry.

A1.1.3.2.3 Feed Preparation (Phase I) and Wet Phosphate Rock Storage and Reclaim

Type of Plant: After leaving the beneficiation plant and prior to dewatering, a new feed preparation section will be added in Phase I. All the phosphate rock will be screened as a slurry. The coarse

fraction will be dried and ground in existing equipment. The fine fraction (28 mesh or smaller) will be transported in a new belt to the Suwannee River Chemical Complex as wet rock product.

All product from the beneficiation plant is conveyed as a slurry to cyclones in which the water is separated and pumped to the pond area. The underflow product (wet concentrate) is deposited in the dewatering bins and wet storage area.

The dewatered wet rock is stored in the open area. Material is fed to the Suwannee River Chemical Complex by conveyor belt or to the dryer area.

Capacity: The total wet rock concentrate produced is approximately 2,500,000 tons/yr. Of this amount, approximately 40 percent is dried and the remainder shipped as wet rock concentrate to the Suwannee River Chemical Complex.

Storage: The overall storage facilities will hold approximately 1,000,000 tons. Most of the wet rock is stored outside. The remainder is stored in 6 dewatering bins. Each dewatering bin has a storage capacity of 1,275 tons.

Air Emissions: Since the processing and storage of the concentrate is wet, no particulate matter is emitted into the air stream. No permits are required.

Water Use: The water balance of this area is included in the water balance of the beneficiation area shown in Table A1.1-5 as MGD and in Table A1.1-6 as GPM.

A1.1.3.3 Pond Facilities

Mud balls and clay slurries are pumped to these ponds from the beneficiation plant. The solids settle out and the clear water is recycled to the mining and beneficiation areas. Excess water is discharged from the pond area which will be explained in more detail later in the report. Facilities are designed as covered under Florida's earthen dam requirements Chapter 17-9, Florida Administrative Code (FAC).

The tailings from the beneficiation plant are generally pumped to mine pits or used for building retaining walls (dikes) for the clay ponds. In both cases, clear overflow water is returned to the mine circuit recycle system.

Size and Capacity: The clay ponds currently used in the Suwannee River Mine are shown in aerial map, Figure A1.1-2. In Figure A1.1-5, the area of future pond expansion is shown, and outfall overflows are shown in Figure A1.1-6. These ponds are generally constructed on mined-out land. Tailings are frequently used to build the dikes which are constructed according to specifications established by the State of Florida.

These clay ponds are briefly described below:

1. Settling Area No. SR-1

This area contains approximately 89 acres and is located in Section 1, Twp. 1N, Rge. 15E. It is a retired settling area. The crest elevation of the dikes is 148 feet mean sea level (M.S.L.) with a design pond level elevation of 143 feet M.S.L. The area contains two spillways.

2. Settling Area No. SR-2

This area contains approximately 68 acres and is located in Sections 35 and 36, Twp. 1N, Rge. 15E. It is a retired settling area. The crest elevation of the dikes is 147 ft M.S.L. with a design pond level of 142 ft M.S.L. It contains two spillways and is interconnected with 3A.

3. Settling Area No. SR-3A

This area contains approximately 77 acres and is located in Sections 35 and 36, Twp. 1N, Rge. 15E. It is a retired settling area. The crest elevation of dikes is 147 ft. M.S.L. with a design pond elevation of 142 ft M.S.L. It contains one additional spillway.

4. Settling Area No. SR-3B

This is an active area containing approximately 71 acres and is located in Section 35, Twp. 1N, Rge. 15E. Waste materials are drawn from area No. 4 through a culvert on the north side. This area contains one spillway. The crest elevation of the dikes is 157 ft M.S.L. with a design pond elevation of 152 ft M.S.L.

5. Settling Area No. SR-4

This is an active area of approximately 725 acres located in Sections 25, 26, 35, and 36, Twp. 1N, Rge. 15E. Waste materials are discharged into the southeast corner and clear water is recovered from four spillways located on the west and north sides. The crest elevation of the dikes is 157 ft M.S.L. with a design pond elevation of 152 ft M.S.L.

6. Settling Area No. SR-5-6A

This is an active area that contains approximately 458 acres and is located in Section 36, Twp. 1N, Rge. 15E and Section 31, Twp. 1N, Rge. 16E. Waste materials are introduced in the

southwest corner and pulled from a spillway in the northeast corner. There is one additional spillway. The crest elevation of the dikes is 142 ft M.S.L. with a design pond elevation of 137 ft M.S.L.

7. Settling Area No. SR-6B

This is an active area of approximately 237 acres located in Sections 29 and 30, Twp. 1N, Rge. 16E. Waste materials flow into the southwest corner from area No. 5-6A. Clear water is recovered from two spillways located on the east side. The crest elevation of the dikes is 138 ft M.S.L. with a design pond elevation of 133 ft M.S.L.

8. Settling Area No. SR-8

This is an active area of approximately 830 acres located in Section 25, Twp. 1N, Rge. 15E and Section 30, Twp. 1N, Rge. 16E. Waste materials flow into the area from the south from area No. 5-6A. Clear water is recovered from two spillways located on the north side and two spillways located on the east side. The crest elevation of the dikes is 147 M.S.L. with a maximum pond elevation of 142 ft M.S.L.

9. Settling Area No. SR-9

This is an area of approximately 430 acres located in Section 6, Twp. 1S, Rge. 16E, which has recently been placed in operation. The crest elevation of the dikes is 157 ft M.S.L. with a maximum pond elevation of 152 M.S.L.

Within the clay pond boundary line shown on Figure A1.1-3, rainwater is retained and drained to the mine water recycle system. The total area of the ponds which contain water is 2,985 acres. The total area within the clay pond boundary limits in which rainfall is retained and drained to the mine water recycle circuit, is 4,393 acres.

A total of 3,422,000 tons a year of clays and 1,989,000 tons a year of mud balls are retained in these ponds. The settled clay slurries contain approximately 77 percent water, and settled mudball slurries contain 25 percent

water. After the mining operation has stopped and the land reclaimed according to the laws of the state of Florida, the ponds remain and are frequently used for recreational facilities (boating, fishing, etc.).

There are 7,431,000 tons of tailings a year which are used for building dams and land fill in reclamation of Mined-out land, Mined-out Pit No. 1 shown in the aerial map, Figure A1.1-2, is currently in use as a tailings pond. After the clear water is drained and pumped to the mine water recycle circuit, the tailings retain approximately 15 percent water.

Air Emissions: Since all solid materials in this area are handled as slurries with water, there are no solid particulate emissions and no air permits are required.

Water Recycle and Discharge: Most of the clear mine water overflow from the ponds is recycled within the mining area. The excess mine water is discharged to Altman Bay Canal. The overflow from Altman Bay Canal mixes with the nonprocess effluent from the Suwannee River Chemical Complex and the mine water from Swift Creek Mine ultimately discharging into Swift Creek after passing through NPDES Sample Point 001.

The mine water recycle overflow is pumped to the mine pits and to the beneficiation area. The amount of recycled mine water is 100,000 GPM as compared to the discharge flow of 5,835 GPM. Therefore, 94.5 percent of the total overflow from the ponds is recycled with only 5.5 percent being discharged.

Mine water, primarily rainfall, is discharged at NPDES sampling point 002 which discharges into Hunter Creek as shown in aerial survey map, Figure A1.1-2. The water balance of the pond area is shown in Table A1.1-7 as MGD and Table A1.1-8 as GPM.

Permits: Florida permit IC24-2088 was issued on 3-30-76 for construction of Suwannee River Settling Area No. 9. This is for construction of ponds for settling clays and mud balls. Florida permit IC24-4689 was issued 11-21-77 for No. 10 Settling Area. EPA discharge points 001 and 002 were established in EPA permit Fla. 0000655. All permits are currently in force.

Table A1.1-9 shows allowable effluent limitations now existing and proposed for these sample points (001 and 002) and for new sample points 001-5 and 001-8.

The following two operation permits are in force for existing settling areas: I024-2048; and I024-2096.

A1.1.3.4 Dryers; Dry Phosphate Rock Storage, Shipping and Transport;
and Dry Rock Grinding Facilities

A1.1.3.4.1 Dryer Facilities

Type of Plant: Wet rock is reclaimed from the wet rock storage pile by a tunnel conveyor belt which feeds wet rock to two Dorr-Oliver fluosolids

dryers. The dried rock is then conveyed to dry rock storage silos. The dryers can be heated by either natural gas or No. 2 fuel oil.

The effluent gas from the dryers pass through wet cyclonic scrubbers which remove the solid particulate matter.

Capacity of Plant: Each of the two dryers has a rated capacity to dry 300 tons per hour of wet phosphate rock. However, the actual tonnage that will be dried is approximately 1,000,000 tons/year, or approximately 40 percent of the total concentrate produced.

Air Emissions: The following permits are in force: East dryer, FL.A024-232; West dryer, FL.A024-232. The allowable air emission on existing Florida permits is: East dryer--particulates at 43.12 lb/hr and West dryer--particulates at 43.12 lb/hr.

Water Use: Fresh water is used in the dryer scrubbers. This water is pumped to the pond area and thus is included in the mine water recycle circuit. The water balance for the dryer area, including the dry phosphate rock storage, shipping and transport facilities, is shown in Table A1.1-10 as MGD, and Table A1.1-11 as GPM.

A1.1.3.4.2 Dry Phosphate Rock Storage, Shipping, and Transport Facilities

Type of Plant: The dry phosphate rock is stored in concrete silos. A reclaim system feeds the dry rock to a belt which conveys the dry rock to the Suwannee River Chemical Complex. A small amount is reclaimed and

fed to a small ball milling grinding plant. Alternate reclaim and loading facilities are available to ship rock by rail or truck, but these will remain idle.

The vent air from the storage silos and reclaim system is passed through a small cyclonic scrubber which removes the entrained particulate matter.

Capacity: There are seven silos with a storage capacity of 3,300 tons of dried phosphate rock in each silo. Total storage capacity is 23,100 tons of dried phosphate rock.

Air Emissions: A Florida permit A0242702 for rock drying is currently in force. The allowable air emission on the existing Florida permit is particulates at the 46.8 lb/hr.

Water Use: Fresh water used in the dryer scrubbers is pumped to the pond area and thus is included in the mine water recycle circuit. The water balance is included in the water balance on the dryer facilities shown in Tables A1.1-10 and 11.

A1.1.3.4.3 Dry Rock Grinding Facilities

Type of Plant: This is a small grinding plant with a Hardinge ball mill and air classifier. The ground rock is stored in a small tank. Vent air from the milling, storage and loading is passed through a Mikro-Pulsaire bag collector to remove entrained particulate matter.

Facilities are available to load trucks. The milling and loading operations are intermittent.

Capacity of Plant: The maximum capacity of the plant is 800 tons per day of dried ground rock. Capacity of the storage tank is 96 tons. The total shipments of dry ground rock will be 5 percent - 6 percent of the total wet concentrate produced.

Air Emissions: A Florida permit A024-2324 for rock grinding is currently in force. The allowable air emission on the existing Florida permit is: Particulates at 34.9 lb/hr.

A1.1.4 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF SUPPORT FACILITIES AT SUWANNEE RIVER MINE

A1.1.4.1 Domestic Water Treatment Facilities--Existing

Function: The main sewage treatment facilities serves mine personnel. In addition to the main treatment facilities, there are septic tanks serving the Suwannee River Mine fabrication shop and the Suwannee River Mine supervision trailer.

Type of Plant: The main sewage treatment plant consists of a septic tank, sand filter and tank for treating filtered water. The overflow from the septic tank is pumped to the sand filter and then treated with calcium hypochlorite tablets (containing free chlorine). The effluent water is added to the mine recycle water circuit.

Capacity: The capacity of the main treatment plant is 3,000 gal/day. The two septic tanks use very small amounts of water. Their water use is included in the 3,000 gal/day.

Water Balance: Treated water is discharged to the Suwannee River Mine system. Water use is included in the balance shown in Table A1.1-1 as MGD and in Table A1.1-2 as GPM.

Permits: There is no permit on the main sewage treatment system. The State of Florida granted permission by letter in the late 1960's for the current operating system. Chlorine content of effluent is monitored and maintained at 1 ppm.

Two permits were granted by Hamilton County of the State of Florida for the septic tanks. For the Suwannee River Mine fabrication shop, a septic tank permit was issued 10-15-75, and for the Suwannee River Mine supervision trailer, a septic tank permit was issued 2-15-75.

A1.1.4.2 Fresh Water Supply

Water is supplied by deep wells which have no permits. A description of the Suwannee River Mine Wells is given in Table A1.1-12. The water balance is included in Tables A1.1-1 and 2 and the available well analyses are given in Table A1.1-13.

A1.1.4.3 Electric Power

Electric power will be supplied by Florida Power Corporation.

A1.1.4.4 Boilers

Two very small boilers are used in the flotation plant for process heating purposes. These boilers produce approximately 2,000 lb/hr of

50 psig steam. One boiler is operated most of the year and the second is operated approximately four months out of the year.

A1.1.4.5 Chemicals and Reagents

The chemicals and reagent used include: (1) Small amounts of acid and base for pH adjustment; (2) fatty acids and amines for flotation; (3) kerosene for flotation; (4) water treatment chemicals for two very small boilers used for fuel oil and process heating; and (5) calcium hypochlorite tablets for sewage waste water treatment. The amount of chemical and reagent used is approximately 17 lb/ton of concentrate produced.

A1.1-5 REFERENCES

EPA, NPDES Monthly Reports, Form 158-R0073, January 1976 through First Quarter of 1978.

Florida, State of, Department of Environmental Regulation (FDER), Four FDER Air Permits.

Florida, State of, Department of Environmental Regulation (FDER), Three Dredge and Fill Permits from State of Florida and one applied for.

Florida, State of, Department of Environmental Regulation (FDER) Two Construction Permits from FDER.

Florida, State of, Department of Environmental Regulation (FDER), Three Mine Operation Permits from FDER.

Hamilton County, Florida, Two Permits for Septic Tanks.

OXY/SPA Project Scope, Addendum.

Table A1.1-1 Water Summary (Based on 365 DPY Operating Time)-MGD-Suwannee River Mine-Overall Balance
(Recycle within Mine Circuit is 144 MGD or 94 percent Recycle)

	MGD	
	In	Out
Well Water	10.15	
Rainfall	14.89	
Vent Air (including combustion water)	0.01	
Mine Seepage Water into Cut	1.40	
Wet Matrix Water	2.80	
Solar Evaporation		11.25
Deposited Water with Clays		7.60
Deposited Water with Tailings		1.04
Deposited Water with Mud Balls		0.45
Make-Up to SRCC		0.39
Mine Discharge to Surface Waters		8.40
Water in Wet Rock Product		0.18
Water in Dry Rock Product		0.01
Scrubber Stack		0.01
Sanitary & Regeneration Water from SRCC	0.17	
TOTAL OVERALL BALANCE	29.42	29.42

Table A1.1-2 Water Summary (Based on 365 DPY Operating Time)-GPM-Suwannee River Mine-Overall Balance (Recycle within Mine Circuit is 100,000 GPM or 94 percent Recycle)

	In	GPM Out
Well Water	7,051	
Rainfall	10,339	
Vent Air (including combustion water)	10	
Mine Seepage Water into Cut	973	
Wet Matrix Water	1,940	
Solar Evaporation		7,814
Deposited Water with Clays		5,280
Deposited Water with Tailings		719
Deposited Water with Mud Balls		316
Make-Up to SRCC		272
Mine Discharge to Surface Waters		5,835
Water in Wet Rock Product		120
Water in Dry Rock Product		7
Scrubber Stack		70
Sanitary & Regeneration Water from SRCC	120	
TOTAL OVERALL BALANCE	20,433	20,433

Table A1.1-3 Water Summary (Based on 365 DPY Operating Time)-
MGD-Suwannee River Mine-Mine Cut

	In	MGD Out
MINE CUT:		
Recycle Water from Settling Pond	16.56	
Mine Seepage	1.40	
Wet Matrix	2.80	
Matrix Slurry Water		20.76
TOTAL MINE CUT	20.76	20.76

Table A1.1-4 Water Summary (Based on 365 DPY Operating Time)-
GPM-Suwannee River Mine-Mine Cut

	In	GPM Out
MINE CUT:		
Recycle Water from Settling Pond	11,503	
Mine Seepage	973	
Wet Matrix	1,940	
Matrix Slurry Water		14,416
TOTAL MINE CUT	14,416	14,416

Table A1.1-5 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Suwannee River Mine-Beneficiation Plant

	In	MGD Out
BENEFICIATION PLANT:		
Recycle Mine Water	127.44	
Recycle to Settling Ponds		148.65
Sanitary Water & Regeneration Water from SRCC	0.17	
Well Water	9.67	
Matrix Slurry Water	20.76	
Wet Rock to Dryer Area		0.12
Wet Rock Product		0.18
Clays to Settling Pond		7.60
Tailings to Settling Pond		1.04
Mud Balls to Settling Pond		0.45
TOTAL BENEFICIATION PLANT	158.04	158.04

Table A1.1-6 Water Summary (Based on 365 DPY Operating Time)
 -GPM-Suwannee River Mine-Beneficiation Plant

	In	GPM	Out
BENEFICIATION PLANT:			
Recycle Mine Water	89,497		
Recycle to Settling Ponds			103,232
Sanitary Water & Regeneration Water from SRCC		120	
Well Water	6,716		
Matrix Slurry Water	14,416		
Wet Rock to Dryer Area			82
Wet Rock Product			120
Clays to Settling Pond			5,280
Tailings to Settling Pond			719
Mud Balls to Settling Pond			316
TOTAL BENEFICIATION PLANT	109,749		109,749

Table A1.1-7 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Suwannee River Mine-Settling Ponds

	In	MGD	Out
Rainfall	14.89		
Recycle from Beneficiation Area	148.61		
Dryer Scrubber Outlet	0.50		
Clays	7.60		
Tailings	1.04		
Mud Balls	0.45		
Recycle to Mine & Beneficiation Operations			144.00
Discharge to Surface Waters			8.36
Make-Up to SRCC			0.39
Solar Evaporation			11.25
Deposited in Settling Ponds (Clays, Tailings, Mud Balls)			9.09
TOTAL SETTLING PONDS	173.09		173.09

Table A1.1-8 Water Summary (Based on 365 DPY Operating Time)
 -GPM-Suwannee River Mine-Settling Ponds

	In	GPM	Out
Rainfall	10,339		
Recycle from Beneficiation Area	103,232		
Dryer Scrubber Outlet	350		
Clays	5,280		
Tailings	719		
Mud Balls	316		
Recycle to Mine & Beneficiation Operations			100,000
Discharge to Surface Waters			5,835
Make-Up to SRCC			272
Solar Evaporation			7,814
Deposited in Settling Ponds (Clays, Tailings, Mud Balls)			6,315
TOTAL SETTLING PONDS	120,236		120,236

Table A1.1-9

Allowable Effluent Limitations on Existing Permits

	<u>Existing NPDES Permit</u>		<u>Existing EPA Guidelines</u>		<u>Proposed EPA Permit</u> ⁽¹⁾	
	Daily Av. MG/L	Daily Max. MG/L	Daily Av. MG/L	Daily Max. MG/L	Daily Av. MG/L	Daily Max. MG/L
TSS		90	30	60	30	60
Total Phosphorus (as P)		10				
Fluoride		10				
Ra-226			-	-	9 pCi/L	9 pCi/L
pH	6.0 - 9.0		6.0	9.0	6.0	- 9.0

(1) 10/31/77

Table A1.1-10 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Suwannee River Mine-Dryer Area

	In	MGD	Out
DRYER AREA:			
Well Water to Dryer Scrubbers	0.48		
Vent Air (including fuel combustion water)	0.01		
Wet Rock Feed	0.12		
Dry Rock Product			0.01
Stack			0.10
Dryer Scrubber Outlet Recycle to Pond Area			0.50
TOTAL DRYER AREA	0.61		0.61

Table A1.1-11 Water Summary (Based on 365 DPY Operating Time)
 -GPM-Suwannee River Mine-Dryer Area

	In	GPM	Out
DRYER AREA:			
Well Water to Dryer Scrubbers	335		
Vent Air (including fuel combustion water)	10		
Wet Rock Feed	82		
Dry Rock Product			7
Stack			70
Dryer Scrubber Outlet Recycle to Pond Area			350
TOTAL DRYER AREA	427		427

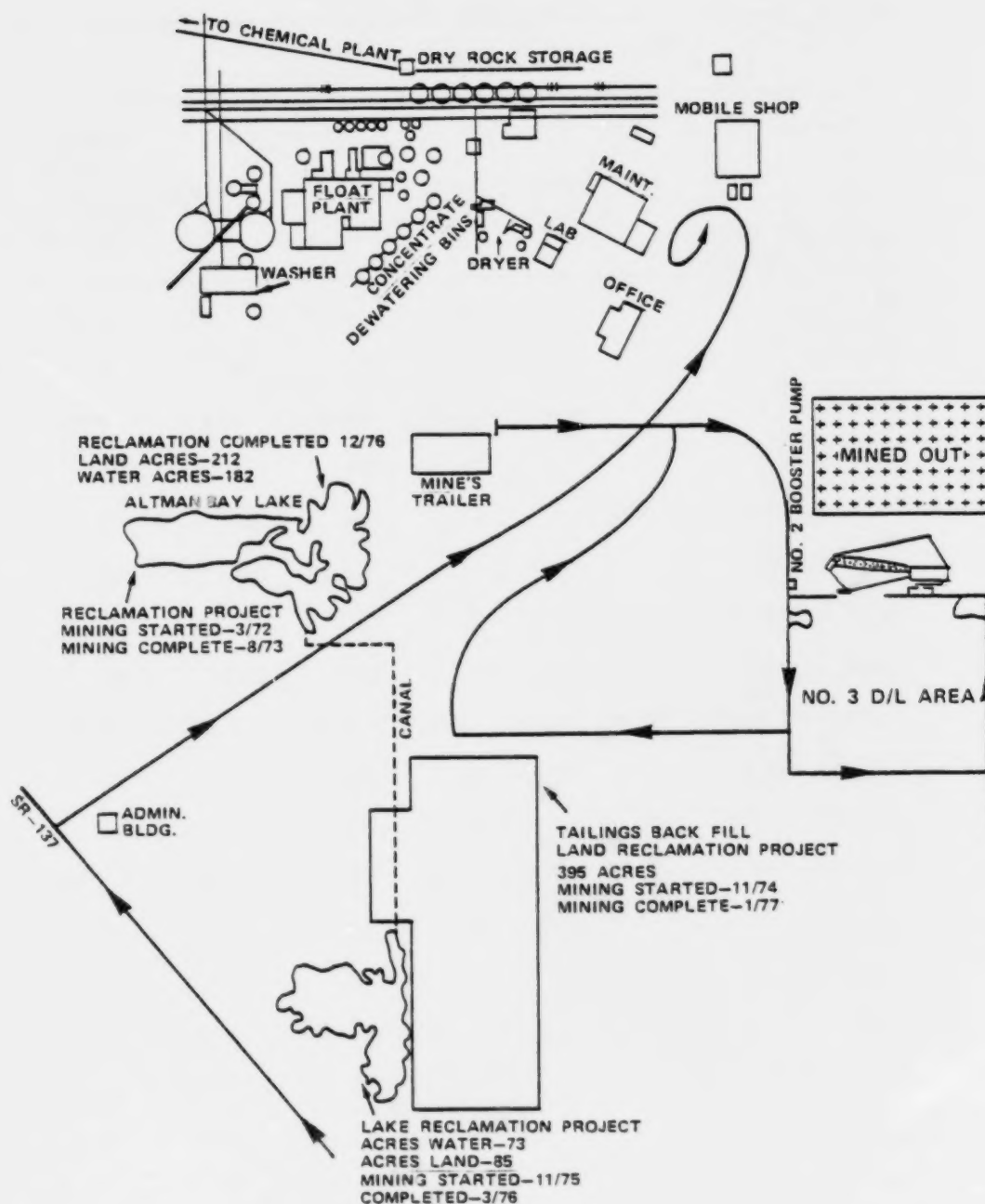
Table A1.1-12 Description of Wells-Suwannee River Mine

Well No.	Name	Capacity, Test, GPM	Depth, Feet	Casing
M-1	Suwannee River Mine No. 1	5,000	1,265	30"/24"
M-2	Suwannee River Mine No. 2	1,700	700	20"/16"
M-3	Suwannee River Mine No. 3	5,000	804	34"/26"
MD-1	Suwannee River Mine No. 1	200	201	6"
MD-2	Suwannee River Mine No. 2	60	190	4"
--	Mines Supervisors' Trailer	60	240	8"

Table A1.1-13 Suwannee River Mine-Fresh Water Analyses

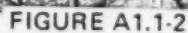
CERTIFICATE OF ANALYSIS ⁽¹⁾⁽²⁾					
Laboratory Marks	Deep Well M-1	Deep Well M-2	Potable Well MD-1	Potable Well MD-2	Potable Well Mine Supervisors Trailer
pH	7.1	6.65	7.38	7.65	7.85
Color	30	30	10	20	5
Odor	None	Indef.	None	None	None
Alkalinity	174	143	204	170	161
Total Hardness as CaCO ₃	227	173	224	214	148
Total Solids	335	243	303	318	231
Total Volatile Solids	117	96	103	118	71
Fixed Solids	218	147	200	200	160
Nitrate Nitrogen (NO ₃ -N)	0.20	0.18	0.16	0.08	0.11
Sulfate (SO ₄)	66	36	34	52	13
Chloride (Cl)	16	16	15	20	11
Fluoride (F)	0.41	0.33	0.64	0.68	0.88
Calcium (Ca)	81	66	64	59	52
Magnesium (Mg)	5.7	7.7	16	16	3.9
Iron (Fe)	0.54	0.36	0.37	0.85	0.45
Sodium (Na)	12	8.5	9.36	11	6.5
Potassium (K)	1.6	1.0	0.98	0.90	0.88
Non-Carbonate Hardness as CaCO ₃	53	30	20	44	13
Silica (SiO ₂)	30	23	34	33	33
Sodium Chloride (NaCl)	26	26	25	33	18
Hydrogen Sulfide	0.52	1.0			

⁽¹⁾ Thornton Laboratories, Tampa, Florida 3/4/76⁽²⁾ All analysis in parts per million except pH, color and odor
1-104



SUWANNEE RIVER MINE-GENERAL LAYOUT

FIGURE A1.1-1



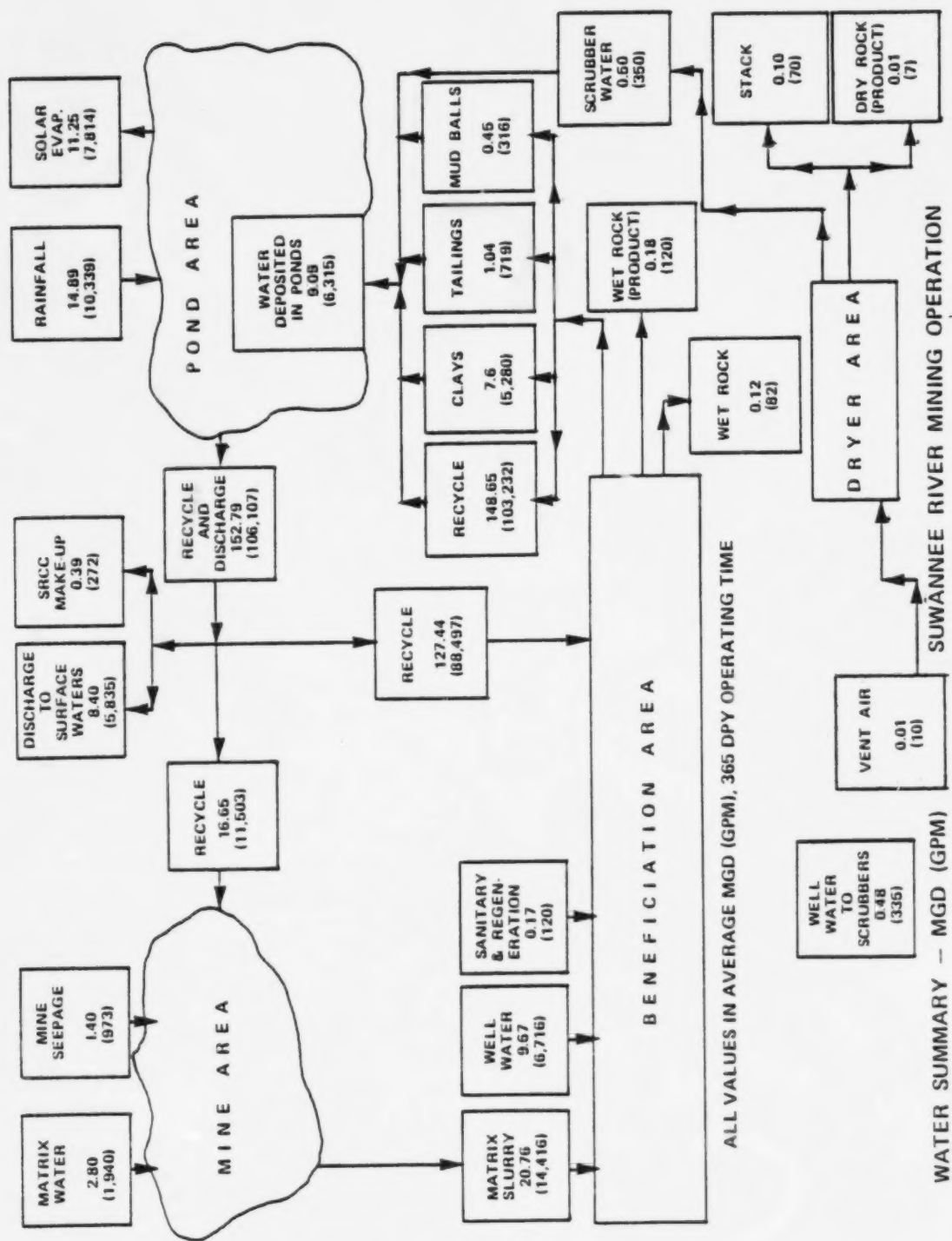
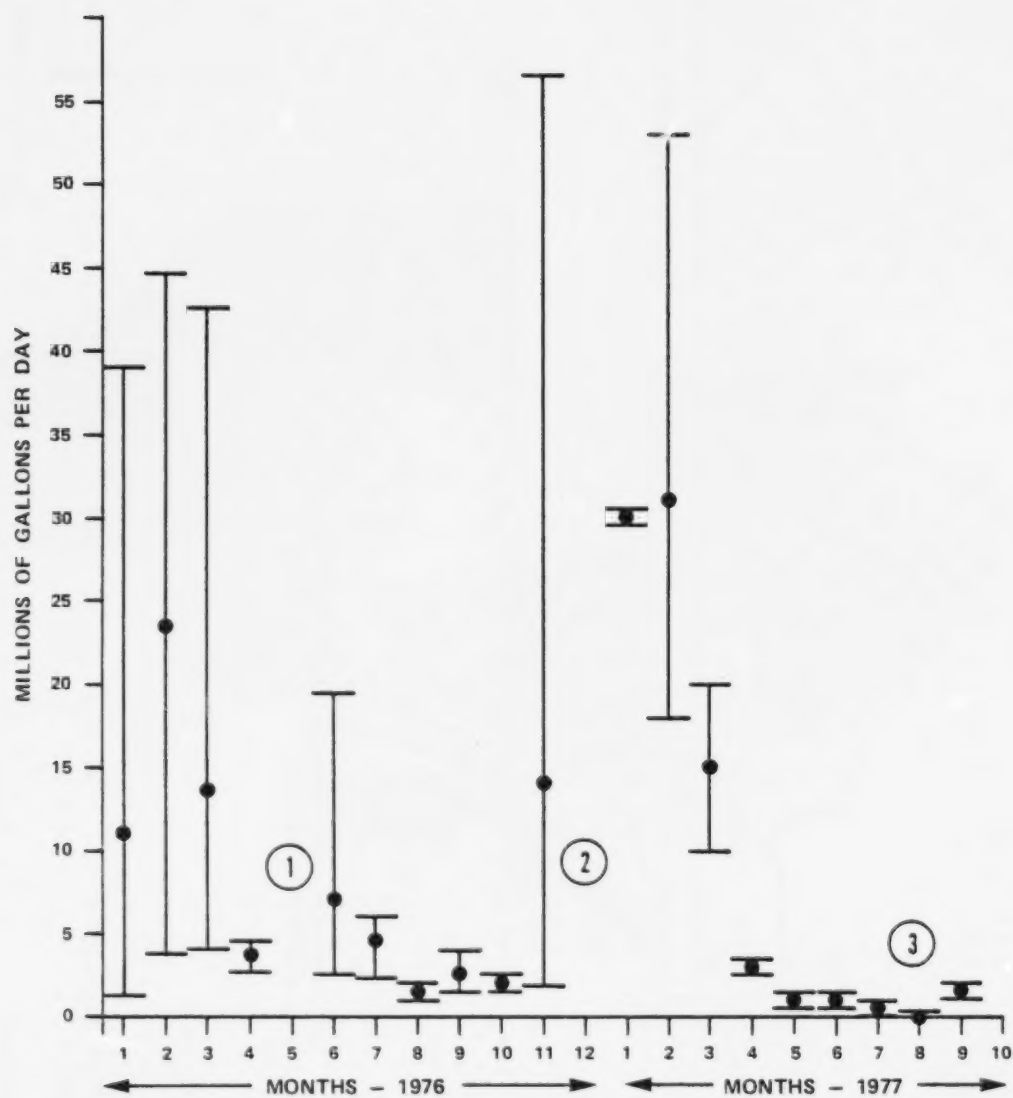


FIGURE A1.1-3



FLOW DISCHARGE RATES IN MILLIONS OF GALLONS PER DAY FOR PERIOD 1/76 THRU 9/77

- ① NO READING RECORDED
- ② SAMPLE POINT FLOODED
- ③ NO FLOW DURING THE MONTH

- MAXIMUM DAILY FLOW DURING THE MONTH
- AVERAGE DAILY FLOW DURING THE MONTH
- MINIMUM DAILY FLOW DURING THE MONTH

DISCHARGE POINT 002

FIGURE A1.1-4

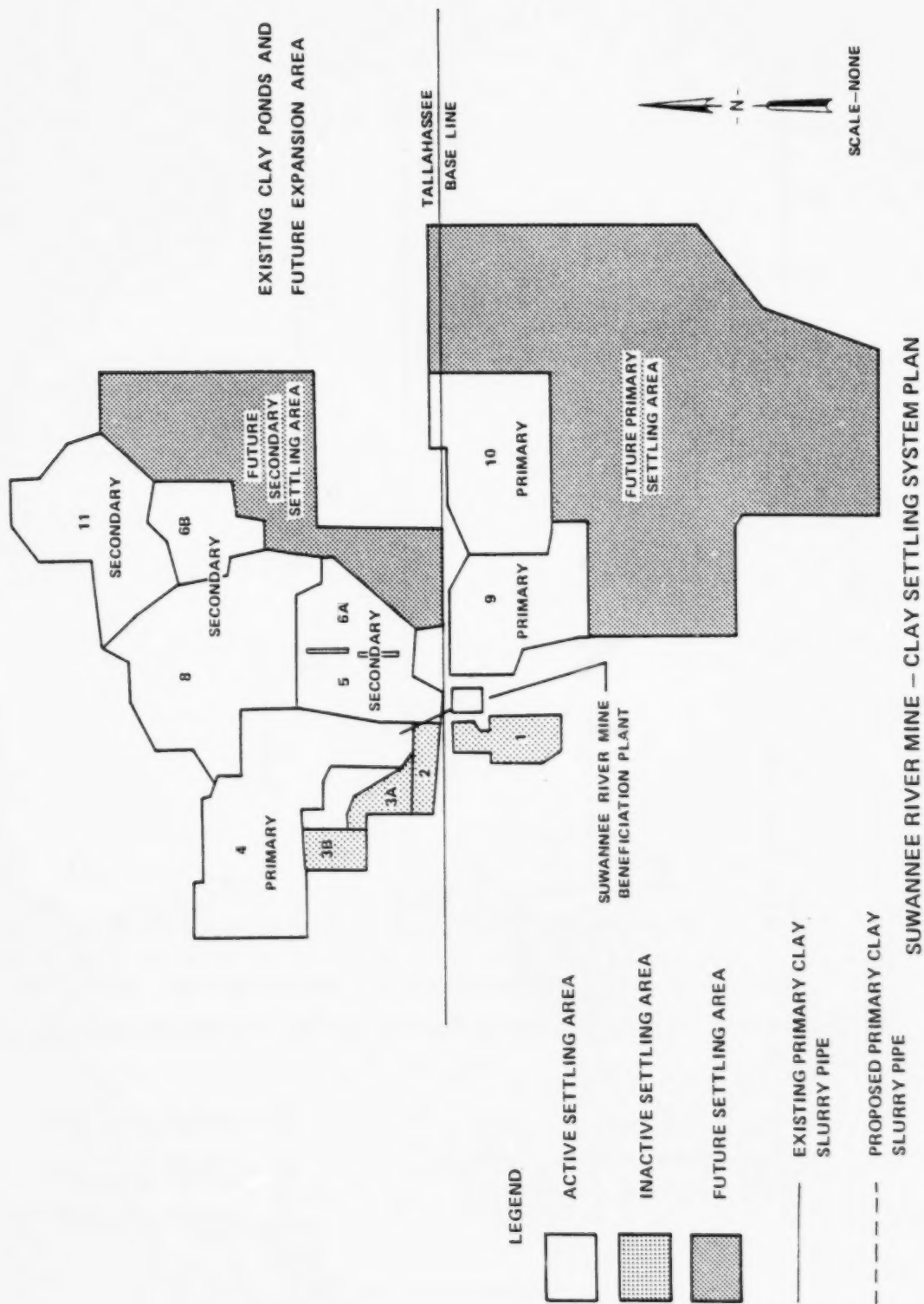
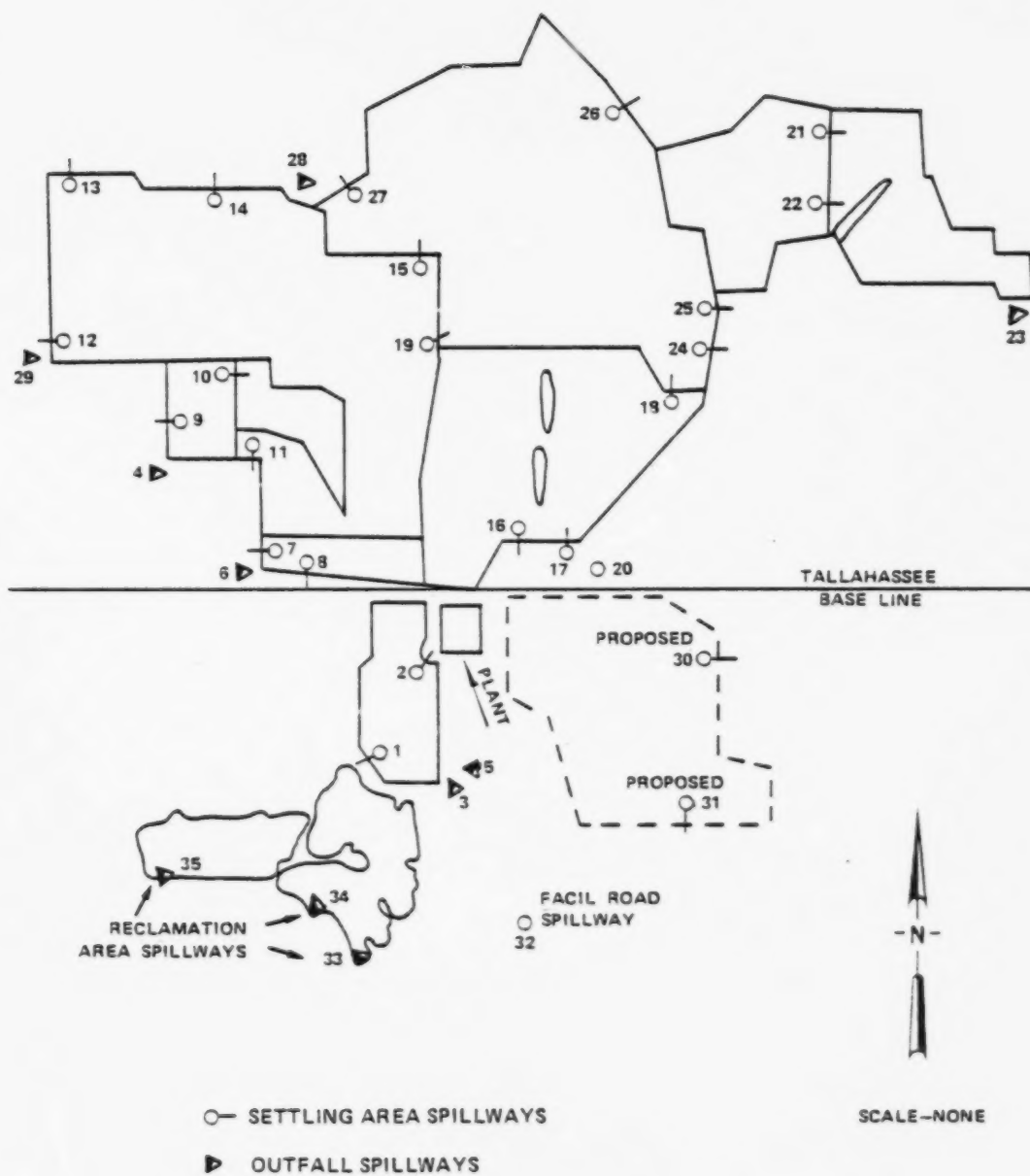


FIGURE A1.1-5



SUWANNEE RIVER MINE- SPILLWAY LOCATIONS IN CLAY PONDS

FIGURE A1.1-6

APPENDIX A1.2
DESCRIPTION OF PROPOSED FACILITIES

A1.2 EXISTING SWIFT CREEK MINE (SCM) AND BENEFICIATION PLANT
PLUS PHASE II MODIFICATIONS

A1.2.1 INTRODUCTION

A1.2.1.1 Index

A1.2 EXISTING SWIFT CREEK MINE (SCM) AND BENEFICIATION PLANT
PLUS PHASE II MODIFICATIONS

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A1.2.2.2 Capacity

A1.2.2.3 Ore Body

A1.2.2.4 Mining Facilities

A1.2.2.5 Beneficiation Facilities

A1.2.2.6 Pond Facilities

A1.2.2.7 Dryer Facilities & Dry Phosphate Rock
Storage, Shipping, and Transport

A1.2.2.8 Support Facilities

A1.2.2.9 Mine Water Balance

A1.2.2.10 Water Discharges

A1.2.2.11 Permits

A1.2.3 DESCRIPTION & ENVIRONMENTAL ASPECTS OF EXISTING
FACILITIES PLUS PHASE II MODIFICATIONS - SCM

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A1.2.3.2 Beneficiation Facilities, Feed Preparation
(Phase II) and Wet Phosphate Rock Storage
and Reclaim

A1.2.3.2.1 Washer

A1.2.3.3.2 Flotation Plant

A1.2.3.3.3 Feed Preparation (Phase II)
and Wet Phosphate Rock Storage and
Reclaim

A1.2.3.3 Pond Facilities

A1.2.3.4 Dryers; Dry Phosphate Rock Storage,
Shipping and Transport

A1.2.3.4.1 Dryer Facilities

A1.2.3.4.2 Dry Phosphate Rock Storage, Shipping,
& Transport Facilities

A1.2.4 DESCRIPTION & ENVIRONMENTAL ASPECTS OF SUPPORT
FACILITIES - SCM

A1.2.4.1 Domestic Water Treatment
Facilities - Existing

A1.2.4.2 Fresh Water Supply - Existing

A1.2.4.3 Electric Power

A1.2.4.4 Boilers

A1.2.4.5 Chemicals and Reagents

A1.2.5 REFERENCES

A1.2.1.2 List of Figures

- A1.2-1 Swift Creek Mine Water Systems
- A1.2-2 Water Summary - MGD (GPM) - Swift Creek Mining Operation
for Dihydrate Process
- A1.2-3 Swift Creek Mine Water Systems
- A1.2-4 Settling Area No. 2 Swift Creek Mine Occidental Chemical
Company - Pond Systems
- A1.2-5 Swift Creek Mine - Domestic Waste Water Treatment

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Swift Creek Mine - Overall Balance
- A1.2-2 Water Summary (Based on 365 DPY Operating Time) - GPM -
Swift Creek Mine - Overall Balance
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Swift Creek Mine - Mine Cut
- A1.2-4 Water Summary (Based on 365 DPY Operating Time) - GPM -
Swift Creek Mine - Mine Cut
- A1.2-5 Water Summary (Based on 365 DPY Operating Time) - MGD -
Swift Creek Mine - Beneficiation Plant
- A1.2-6 Water Summary (Based on 365 DPY Operating Time) - GPM -
Swift Creek Mine - Beneficiation Plant
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Swift Creek Mine - Settling Ponds

- A1.2-8 Water Summary (Based on 365 DPY Operating Time) - GPM -
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- A1.2-9 Allowable Effluent Limitations on Existing Permits
- A1.2-10 Water Summary (Based on 365 DPY Operating Time) - MGD -
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- A1.2-12 Description of Wells - Swift Creek Mine
- A1.2-13 Swift Creek Mine - Fresh Water Analyses
- A1.2-14 Swift Creek Mine - Fresh Water Analyses - Certificate of
Analysis

A1.2.1.4 Abbreviations and Definitions

Av. - Average

BACT - Best Available Control Technology

BPL - Bone Phosphate of Lime

DPY - Days per Year

F - Fluoride

GFP&A - Gordon F. Palm & Associates, Inc.

GPM - Gallons (U.S.) per Minute

Lb. or Lbs. - Pound or Pounds

Matrix - Phosphate ore which includes product, clays, and tailings

MGD - Millions of Gallons per Day

MG/L - Milligrams per Liter

MTPY - Metric tons per year (2,205 lbs)

Overburden - Top Soil above the phosphate deposit

OXY - Occidental Petroleum Corporation

P O - Phosphoric Acid

2 5

pCi/L - Picocuries per Liter

ppm - Parts per Million (by wt.)

SCM - Swift Creek Mine

SPA - Superphosphoric Acid

SRCC - Suwannee River Chemical Complex

SRM - Suwannee River Mine

STPH - Short Tons per Hour (2,000 lbs.)

STPY - Short Tons per Year (2,000 lbs.)

' - Feet

" - Inches

Tailings - Sand

A1.2.2 MINE DESCRIPTION

Operation of the Swift Creek Mine (SCM) began in November 1975. The first dragline was delivered in June 1975. There are now two draglines with the third scheduled for delivery in 1980.

With the addition of the third dragline and pumping system, it is possible to feed the Beneficiation Plant with two mining and pumping systems at one time, while the third dragline is stripping a front.

For Phase II of the Russian SPA project, a rock preparation section will be added. This will screen wet concentrate and remove particles larger than 28 mesh to prepare the feed to the proposed Swift Creek Chemical Complex (SCCC) which is scheduled to start operations in 1980. A conveyor belt will be installed to transport wet rock to the proposed Swift Creek Chemical Complex.

Location of the Swift Creek Mine is in Hamilton County in North Florida on a level plot, surrounded by pine trees, northwest of White Springs and just east of U.S. Highway 41. It is approximately halfway between Jasper and White Springs. UTM coordinates are E-321, 242 and N-3, 368, 880. The area location is shown in Figure 1.4-1.

A1.2.2.1 Products

Final products (concentrates) shipped from the mine will consist of wet and dry 68 percent BPL (31.2 percent P2O5) phosphate rock and dry 72) percent BPL (33 percent P2O5) phosphate rock. Approximately 54 percent of the production will be conveyed as wet rock containing approximately 10 percent

water to the proposed Swift Creek Chemical Complex. The remainder will be dried at the Swift Creek Mine and shipped by rail.

A1.2.2.2 Capacity

Total production of phosphate rock concentrate will average about 2,500,000 short tons per year with about 54 percent produced as wet rock to eliminate phosphate rock drying. This reduces fuel consumption and reduces phosphate rock dryer particulate emissions about 54 percent below current levels.

A1.2.2.3 Ore Body

The land-pebble phosphate deposits consist of pebbles and fine phosphatic sand dispersed in nonphosphatic sandy clay. The phosphatic bearing ore (matrix) is covered by a quartz, sand, and clay mixture (overburden). The overburden averages 24 ft in thickness, generally ranging from 10 to 30 ft. The matrix averages 14 ft in thickness, ranging from 10 to 30 ft.

A1.2.2.4 Mining Facilities

Two draglines are used to mine and slurry the matrix. The overburden is first removed and stored in ridges on mined-out land. The matrix is then removed and slurried with water which is recycled from the pond area. The slurry, containing approximately 35 percent solids, is pumped to the beneficiation plant. With the completion of Phase II, a third dragline will be added.

A1.2.2.5 Beneficiation Facilities

The matrix slurry is pumped to the matrix header box which is located above and feeds the trommel screens. Oversize material +5/8 in. to 1 in. can be routed to the mudball sump and pumped to the ponds. Alternatively, this can be fed to hammermills and recycled to the matrix header.

The trommel screen underflow passes through a series of double-deck screens. Overflow from the top deck can be routed to the mudball system or to the rod mill storage bins for milling. The latter product (pebble rock), after milling, is conveyed to the wet rock product (concentrate) storage area. The overflow from the second screen is passed through finishing pebble screens and the final product is conveyed to the wet concentrate storage area.

The double-deck screen underflow is passed through a series of desliming tanks and cyclones and the clays are removed as overflow slurry which is pumped to the clay pond.

Cyclone underflow is sized and passed through the coarse and fine flotation cells. In this operation the tailings (coarse sand with low phosphate content) are separated from the phosphate rock (concentrate). Kerosene, amines, fatty acids, and miscellaneous flotation agents are used for conditioning. Proper pH adjustment of the flotation water is accomplished with acid and/or base. Well water is used for make-up water in this circuit. All tank overflows and secondary slimes pass through a 500 ft diameter thickener which reclaims about 35 percent of the recycled water.

The tailings are removed as a slurry and pumped to the tailings pond area. Clear water overflow is recycled to the mine circuit. Currently the concentrate is dewatered in cyclones and stored in piles in the wet storage area. No storage building is required as the material is coarse and wet. From these piles the material is reclaimed and transferred to the proposed Swift Creek Chemical Complex (SCCC) or to the dryer area.

For Phase II of the Russian project, new facilities will be added so that the concentrate slurry in the flotation plant can be screened prior to dewatering and storage so that 100 percent will pass through a 28 mesh screen. Engineering was started April 1, 1978. Start of construction is scheduled for June 1978, and plant start-up is scheduled for October 1979.

This screening unit will be integrated into the existing plant as a finishing section using existing transportation equipment to existing storage. The product, as dewatered fine and coarse fractions, will be transported to the existing outside pile storage with an existing conveying and stacking system.

A new conveyor belt will also be installed in Phase II to transfer wet rock to the proposed Swift Creek Chemical Complex.

A1.2.2.6 Pond Facilities

Effluent slurries from the washer and flotation plants are pumped to large ponds usually constructed on mined-out lands. Retaining walls

(dikes) of these ponds are built in accordance with rules and regulations established by the state of Florida.

The clays and mudballs are pumped into settling ponds. Clear water effluent is recycled to the mine circuit. Excess, clear water is discharged to Swift Creek at Discharge Point 001. In the clay ponds, the settled slurry contains about 23 percent solids. The settled solids in the mudball ponds contain about 75 percent solids and those in the tailings ponds contain about 85 percent solids.

Since there is excess volume of water in the overall balance between solids removed as concentrate and water retained in the clays and mudball ponds, man-made lakes are created. When mining and excavation of an area is completed, the land is reclaimed in accordance with the laws of the state of Florida.

The man-made lakes provide recreational facilities for boating and fishing. Reclaimed land can be used for agriculture, building, forestation, and recreational projects.

The tailings are generally used to build dikes as well as to provide fill for mined-out land. At the present time, they are being pumped in the mine pit north of SC-1 shown in Figure A1.2-1. The slurry water eventually is recycled to the mine pit or can be returned to the recycle stream entering the beneficiation plant.

A1.2.2.7 Dryer Facilities and Dry Phosphate Rock Storage, Shipping and Transport

Concentrate is reclaimed from wet storage and dried in one fluid bed dryer which is heated by No. 2 fuel oil. The dried product is conveyed to dry rock storage silos. From the silos, the dried rock is loaded into rail cars.

A cyclonic scrubber is used to remove the particulate matter emitted in the dryer exit gas stream. Another cyclonic scrubber removes the particulate matter from ventilation of the dry rock silos, reclaiming, and shipping facilities. Mine recycle water is used in these scrubbers. Particulate matter is removed from scrubber water by recycling through the pond system.

A1.2.2.8 Support Facilities

Support facilities at the Swift Creek Mine consist of administrative offices, laboratory, maintenance shop, mobile shop, mines trailers, fuel oil storage, miscellaneous chemical and reagent storage, electric power substations, roads, railroads, freshwater wells, potable water, domestic sewage systems, compressed air, and two small boilers.

A1.2.2.9 Mine Water Balance

The Swift Creek Mine has two 7,000 GPM freshwater wells at depths of 800 ft. The two 7,000 GPM wells are operated mainly in the dry season.

Two potable wells, 200 GPM and 30 GPM, at depths of 240 ft and 75 ft, supply all potable water uses. Treated domestic water is discharged to the Swift Creek Mine water circuit.

Detail water balances were prepared for each mine operation and support facility of the existing Swift Creek Mine plus Phase II expansion to reflect planned operations when Phase II of the Russian SPA project is in full operation. Occidental Chemical Company's project scope; product slate and tonnages; material balances; process unit operating sequences; raw material, intermediate, and product specifications; performance tests of air pollution control equipment; plant reports; aerial photographs of mine ponds (to scale); local weather data; and other information was used together with a knowledge of the existing facilities at Swift Creek Mine and the processes used to develop the detail water balances which are included in the description of each unit or support facility.

An overall water balance is summarized in Figure A1.2-2 for the Swift Creek Mine plus Phase II in terms of MGD (millions of gallons of water per day) and GPM (gallons per minute). Table A1.2-1 and 2 present the same data as MGD and GPM. All are based on an operating time of 365 DPY (days per year). Freshwater requirements are 9.67 MGD (6,714 GPM) and mine discharge water is 4.65 MGD (3,227 GPM).

In the Swift Creek Mine operation, mine water is used to transport the matrix to the beneficiation plant. In this plant, clays, mudballs,

and tailings are removed as slurries and settled in ponds. A small amount of mine water is used in the dryer area scrubbers settled in these ponds. Well water make-up is required primarily for the flotation operation. The excess clear mine water overflow from the ponds is discharged. This flow ultimately discharges into Swift Creek. A flow of 140,000 GPM is recycled from the ponds' overflow in the mining circuit. Well water make-up is 6,714 GPM. Thus, 95.4 percent of this total flow is recycled water.

A1.2.2.10 Water Discharges

Water discharge routes are shown in Figures A1.2-1 and A1.1-2, which are reproductions of aerial photographs of the existing Swift Creek Mine, Suwannee River Mine, and Suwannee River Chemical Complex facilities.

NPDES Discharge Point 001 is in Swift Creek, about 2.2 miles (3.7 km) south of the southwest corner of the Suwannee River Chemical Complex plant site.

Actual flows at EPA Discharge Point 001 for permit FL-0000655, located in Swift Creek, from January 1976 through September 1977 are shown in Figure 1.4-5. These flows include the Suwannee River Mine discharges plus the Suwannee River Chemical Complex and Swift Creek Mine and rainfall run-off; therefore, they cannot be correlated directly with past mines or chemical plant operation or future planned operation at the completion of Phase II. During this period, average flows (based on daily measurements) ranged from 4.0 MGD in May 1977 to 146 MGD in

February 1976, with daily flows ranging from zero in May 1976 to 188.5 MGD in March and April 1976. This compares with average calculated Swift Creek Mine mine water discharge rates of 4.65 MGD. The average discharge rates of nonprocess water from the Suwannee River Chemical Complex is 7.06 MGD and that from the Suwannee River Mine is 8.4 MGD.

As shown in the water balance, the rainfall and solar evaporation are practically equal. This is due to the fact that the mine has just started operation. There are only two ponds--one is for clays and one is for tailings. So the total rainfall area in the pond system is only slightly larger than the wet area (solar evaporation).

In Figure A1.2-3, which was included in a Florida Operating Permit, a retention pond is shown. The Swift Creek primary mine discharge water passes through this pond prior to joining the Suwannee River Chemical Complex and Suwannee River Mine discharge waters and ultimately discharging at NPDES Point 001. This is another clarification pond to insure that the mine water discharge is clear.

A1.2.2.11 Permits

The Swift Creek Mine has several water and air operating permits for the existing operation and several dredge and fill construction permits.

Water permits consist of one EPA NPDES permit and two Florida permits for domestic water treatment. Currently, EPA has proposed a revised NPDES permit and had a public hearing on February 9, 1978 in White Springs, Florida.

Air permits consist of two Florida operating permits for the existing operations. There are two permits (one construction and one operating) for the mine operations.

Figure A1.2-4 shows the location of the clay pond. This was included in a construction permit granted by the State of Florida to enlarge the clay pond (No. 1) which was, at the time, under construction. This is just one example of the strict supervision of pond construction by the state of Florida, as previously mentioned.

A1.2.3 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF EXISTING FACILITIES PLUS PHASE II MODIFICATIONS -- SWIFT CREEK MINE

A1.2.3.1 Mining

Type of Mine: The Swift Creek Mine has 2 draglines. These are 45 cubic yard draglines, page model 752 with 222 foot booms. A third dragline identical to the existing draglines will be installed in 1980.

Capacity of Mine: The total annual capacity of three draglines is rated at over 36,000,000 cu. yd. An average of 17,000,000 (DRY) tons/year matrix is mined which is equivalent to a total of 37,450,000 cu. yd. as mined).

Ore Body Description: The phosphatic ore (matrix) is covered with a layer of sand and quartz (overburden). The overburden is removed and generally stacked in ridges on mined-out land. The overburden ranges from 10 to 30 ft. in thickness averaging 24 ft. The matrix ranges from 5 to 25 ft., averaging 14 ft.

Ore Transport System: There will be three pits in which the matrix is slurried and pumped to the beneficiation plant by use of three Type GIW 20" x 20" LSA 44 pit pumps. The slurry, containing approximately 35 percent solids, is pumped through a 20 in. line to the beneficiation plant as feed stock. Type GIW 18" x 18" SRT 40 GIW pumps are used as booster pumps, usually spaced 5,000 ft apart. Clear recycle overflow water from the ponds is pumped to the pits and used to slurry the matrix.

Air Emissions: Since this operation is essentially a wet handling slurry system, there are no pollutant air emissions or regulations requiring permits in the mining and ore transport areas.

Water Discharge: Mine water used to slurry and transport the matrix to the beneficiation plant is recycled.

As previously mentioned, rain water on surrounding land area drains to Swift Creek, near which NPDES Sample Point 001 is located. Ground water enters the mine water recycle circuit by seepage into the mine cuts.

The water balance for this area is shown in Table A1.2-3 as MGD and Table A1.2-4 as GPM.

Permits: There are no dredge and fill permits. The mine has been inactive for a period of time.

A1.2.3.2 Beneficiation Facilities, Feed Preparation (Phase II), and
Wet Phosphate Rock Storage and Reclaim

A1.2.3.2.1 Washer

Type of Plant: The Swift Creek washer was built to handle two pumping systems, each one feeding 1,500 tons of matrix per hour. Each matrix system consists of three trains. The six trommel screens, one per train, discharge the plus 5/8 in. material onto a mudball conveyor belt, which dumps into the mudball sump and is then pumped away as debris to a disposal area.

The trommel screen underflow is laundered to static dewatering screens of 14 mesh punched plate. The overflow of these screens goes to Allis-Chalmers 6' x 16' low head vibrating screens having 14 mesh ISO-bar screen panels on the decks. The overflow of these six primary vibrating screens goes to six log washers, followed by six double-deck Allis-Chalmers vibrating screens. The top deck of these screens are 1/4 in. opening woven wire cloth and the bottom deck has 14 mesh ISO-bar screen panels. The top deck overflow material can be routed to the mudball system or to the pebble storage. The bottom deck overflow goes to 6' x 16' Allis-Chalmers low head screens, called pebble finishing screens, having 16 mesh ISO-bar screen panels. The overflow from these six screens can be routed either to the mudball system or to the pebble storage. All of the above screen underflows goes to one desliming tank on each side of the washer. The deslime tanks have

three 1000 HP 18" x 18" GIW SRT40 pumps which pump to twelve 24-in. primary desliming cyclones over each raw feed storage bin.

All usable pebble goes to pebble storage or to rodmill storage bins. The MSI Marcy Rodmill is designed to grind 120 tons of pebble per hour, the discharge of which is pumped to the deslime tanks where it joins the rest of the feed going to the primary cyclones. Pebble on the pebble storage pile is reclaimed by a tunnel belt which conveys the pebble to the rod-mill storage bins as needed.

The primary cyclone overflow, -150 mesh, goes by gravity to the slimes settling area which is still the initial settling area and is above ground enclosed by dams. Here the slimes are dewatered and the water is returned to the plant for reuse. The underflow discharges into feed tanks to the sizing operation of the flotation plant.

Capacity: The washer will handle 17,000,000 tons (dry basis) of matrix a year. Approximately 32.5 percent of the material is clay which is removed and pumped to the clay ponds in which the solids settle, recycling clear overflow water in the mine circuit.

Air Emissions: Since the rock is processed in the wet state, there are no particulate emissions. No permits are required.

Water Use: All water used in the washer operation is mined recycle water. The matrix is pumped in as a 30 percent to 35 percent slurry. Clear recycle mine water overflow from the ponds is used in the washer operations. Clays and mudballs are pumped to ponds as a slurry. The clear overflow from the ponds is the mine recycled water.

Water Balance: A water balance of the beneficiation plant is shown in Table A1.2-5 as MGD and Table A1.2-6 as GPM. The washer is an area in the beneficiation plant.

A1.2.3.2.2 Flotation Plant

Type of Plant: The primary cyclone underflow discharges directly into the raw feed tanks. From the raw feed tanks the feed is pumped to four Hartman-Fabco hydraulic sizers. The sizers split the feed into three portions; the plus 20 mesh material is returned to the washer, the minus 20 mesh plus 35 mesh is routed to the coarse feed storage tanks, and the minus 35 mesh material goes to the fine feed storage tanks.

All of the tank overflows, secondary slimes, flow by gravity to the 500 ft diameter Eimco thickener. This thickener returns about 35 percent of the recycled water to the plant hydraulic water system. The thickener underflow is pumped by two 100 HP 10 x 12 LSA32 GIW pumps to the primary slimes launder to go with the primary slimes to the settling area.

The rougher flotation section consists of ten Wemco flotation cells. The feed is pumped through a density flow meter controlling the density of the load to the rougher conditioners. The density desired is set by the operator from the control room.

Dilution water to the rougher cells, rougher concentrate tanks, and the tailings tanks, is recycle water.

Reagents are fed to the plant in loop lines by centrifugal pumps, Branch lines from the loop are controlled by instruments which are set by the flotation operators from the control room.

Aqueous base flow is controlled to the lead conditioner by pH, while fatty acid mix and kerosene is controlled by flow rate.

Each rougher cell will handle 200 tons of feed per hour; average feed is 1500 to 1700 tons per hour and average concentrate is 325 to 450 tons per hour.

The rougher concentrate is pumped to dewatering cyclones. The cyclone underflow goes to gravity type acid conditioners. The concentrated sulfuric acid flow is controlled automatically by pH controllers working off of the pH monitored by the pH probe located in the deoiling cyclone overflow. The deoiling cyclones are followed by primary deoiling wash boxes, using recycled water, the underflow from which goes to secondary deoiling wash boxes, using deep well water.

The underflow from the secondary wash boxes goes to three Wemco cells with the No. 2 size agitator. The tanks are the same size as the rougher cells. Two cells are used for the fine concentrate and one cell for the coarse concentrate. The amine mix and kerosene are fed from loop lines through flow rate controllers set by the operators.

Dilution water for the secondary wash boxes and the amine cells is furnished by a 7,000 GPM deep well and is the only fresh or nonrecycled water used in the plant.

The plant tailings are dewatered with two 800 H.P. 18" x 18" x 39" SRT 40 GIW pumps which pump to eighteen 24-in. cyclones. The overflow from the cyclones returns to the recycle tank and is used in the rougher cells and as other pump make-up water.

Capacity: The feed to the flotation plant is 11,489,000 tons/yr (dry basis). The wet rock production (concentrate) is 2,544,000 tons/yr. The difference of 8,925,000 tons/yr are tailings.

Air Emissions: There are no particulate emissions or regulations requiring permits as the material is handled as a slurry.

A1.2.3.2.3 Feed Preparation (Phase II) and Wet Phosphate Rock Storage and Reclaim

Type of Plant: After leaving the beneficiation plant and prior to dewatering, a new feed preparation section will be added in Phase II.

All the phosphate rock will be screened as a slurry. The coarse fraction will be dried and ground in existing equipment. The fine fraction (28 mesh or smaller) will be transported in a new belt to the proposed Swift Creek Chemical Complex as wet rock product.

Water from belt sprays and dewatering of wet rock in the 2-hour surge bin will be discharged to the Swift Creek Mine water circuit. Table 1.4-4 summarizes water uses and discharges.

The products from the beneficiation plant are conveyed as a slurry to cyclones in which the water is separated and pumped to the pond area. The overflow product (wet concentrate) is deposited in the dewatering bins and wet storage area.

The dewatered wet rock is stored in the open area. Material is fed to the proposed Swift Creek Chemical Complex by conveyor belt or to the dryer area.

Capacity: The total wet rock concentrate produced is approximately 2,500,000 tons/yr. Of this amount, approximately 46 percent is dried and the remainder shipped as wet rock concentrate to the proposed Swift Creek Chemical Complex.

Storage: The overall storage facilities will hold approximately 1,000,000 tons. Most of the wet rock is stored outside. The remainder is stored in 8 dewatering bins. Each dewatering bin has a storage capacity of 1,350 tons.

Air Emissions: Since the processing and storage of the concentrate is wet, no particulate matter is emitted into the air stream. No permits are required.

Water Use: The water balance of this area is included in the water balance of the beneficiation area shown in Table A1.2-5 as MGD and in Table A1.2-6 as GPM.

A1.2.3.3 Pond Facilities

Function: Mudballs and clay slurries are pumped to these ponds from the beneficiation plant. The solids settle out and the clear water is recycled to the mining and beneficiation areas. Excess water is discharged from the pond area which will be explained in more detail later in the report.

The tailings from the beneficiation plant are generally pumped to mine pits or used for building retaining walls (dikes) for the clay ponds. In both cases, clear overflow water is returned to the mine circuit recycle system.

Size and Capacity: The clay and tailings ponds currently used in the Swift Creek Mine are shown in aerial map, Figure A1.2-1. Since this is practically a new mine, there are only two ponds. SC-1 is the clay pond and SC-Tailings is the tailings pond.

As mining progresses, more clay ponds will be constructed on mined-out land. Tailings are generally used to construct the dikes. Construction permits must be obtained from the state of Florida prior to expanding the pond system.

The area inside the clay pond SC-1 is 530 acres. The area inside SC-tailing pond is 500 acres.

Within the pond boundary line shown on Figure A1.2-1, rain water is retained and drained to the mine water recycle system. The total area of the ponds which contain water is 1,030 acres. The total area within the pond boundary limits in which rainfall is retained and drained to the mine water recycle circuit, is 1,122 acres. The low ratio of rain water to wet acres of 1.09 is due to the fact that mining operations have barely started. In the Suwannee River Mine, for example, this ratio is 1.47 to 1. The Suwannee River Mine has been in operation since 1965.

A total of 3,454,000 tons a year of clays and 2,077,000 tons a year of mudballs will be retained in the clay ponds. The settled clay slurries contain approximately 77 percent water, and settled mudball slurries contain 25 percent water. After the mining operation has stopped and the land reclaimed according to the laws of the state of Florida, the ponds remain and are frequently used for recreational facilities (boating, fishing, etc.).

There will be a total of 8,925,000 tons of tailings a year which are used for building dams and land fill in reclamation of mined-out land.

SC-Tailings pond shown in the aerial map, Figure A1.2-1, is currently in use as a tailings pond. After the clear water is drained and pumped to the mine water recycle circuit, the tailings retain approximately 15 percent water.

Air Emissions: Since all solid materials in this area are handled as slurries with water, there are no solid particulate emissions and no air permits are required.

Water Recycle and Discharge: Most of the clear mine water overflow from the ponds is recycled within the mining area. As shown in Figures A1.2-1 and A1.1-2, mine discharge water is ultimately discharged at NPDES Sample Point 001 after mixing with waters from the Suwannee River Mine and the Suwannee River Chemical Complex. Prior to this junction, the primary discharge from the Swift Creek Mine, as shown in Figure A1.2-3, passes through a retention pond which further insures maximum removal of suspended solids.

Rainfall from the property (outside the pond area) also drains to NPDES Sample Point 001 and Swift Creek.

The water balance of the pond area is shown in Table A1.2-7 as MGD and Table A1.2-8 as GPM.

Permits: Florida permit IC24-2040B was issued on 6-15-75 for construction of SC-1. EPA Discharge Point 001 was established in EPA permit Fla. 0000655 issued 9-24-74.

Table A1.2-9 shows allowable effluent limitations now existing and proposed for sample point 001.

The following operation permits were issued: I024 was issued 7/16/77 and expires 6/16/82.

A1.2.3.4 Dryers: Dry Phosphate Rock Storage, Shipping and Transport

A1.2.3.4.1 Dryer Facilities

Type of Plant: Wet rock is reclaimed from the wet rock storage pile by a tunnel conveyor belt which feeds wet rock to a Dorr-Oliver fluosolids dryer. The dried rock is then conveyed to dry rock storage silos. The dryer is heated by No. 2 fuel oil.

The effluent gas from the dryer passes through a wet cyclonic scrubber which removes the solid particulate matter. The exit scrubber gas vents through two stacks.

Capacity of Plant: The dryer has a rated capacity to dry 600 tons per hour of wet phosphate rock. However, the actual tonnage that will be dried is approximately 1,130,000 tons/year, or approximately 46 percent of the total concentrate. The balance of the rock will not be dried and will be fed to the Swift Creek Chemical Complex.

Air Emissions: The dryer facilities have a Florida permit A024-2600 issued 8-15-76. The allowable air emission on the existing Florida permit is particulates 46.79 lb /hr at 500 tons per hour operating rate.

Water Use: Mine recycle water is used in the dryer scrubbers. This water is pumped to the pond area and thus is included in the mine water recycle circuit.

The water balance for the dryer area, including the dry phosphate rock storage, shipping and transport facilities, is shown in Table A1.2-10 as MGD, and Table A1.2-11 as GPM.

A1.2.3.4.2 Dry Phosphate Rock Storage, Shipping and Transport Facilities

Type of Plant: The dry phosphate rock from the fluid bed dryer is transported to concrete silos. Reclaim and loading facilities are available to ship rock by rail. The vent air from the storage silos and reclaim system is passed through a small cyclonic scrubber which removes the entrained particulate matter.

Capacity: There are seven silos with a storage capacity of 3,100 tons of dried phosphate rock in each silo. Total storage capacity is 21,700 tons of dried phosphate rock.

Air Emissions: This plant has a Florida permit A0-24-2703 issued 7-29-77. The allowable air emission on existing Florida permit is: Particulates at 46.0 lb/hr.

Water Use: Mine recycled water is used in the dryer scrubbers. This water is pumped to the pond area and thus is included in the mine water recycle circuit. The water balance is included in the water balance on the dryer facilities shown in Tables A1.2-10 and 11.

A1.2.4 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF SUPPORT FACILITIES AT SWIFT CREEK MINE

A1.2.4.1 Domestic Water Treatment Facilities--Existing

Function: The main sewage treatment facilities serve mine personnel. In addition to main treatment facilities, there is the septic tank serving the Swift Creek Mine mobile shop.

Type of Plant: The sewage treatment plant consists of a package unit in which the sewage is treated with chlorine. The effluent is added to the mine recycle water system. Figure A1.2-5 is a line diagram showing the flow and treatment of sewage in the Swift Creek Mine.

Capacity: The capacity of the main treatment plant is 3,000 gal./day. The septic tank uses very small amounts of water. This water use is included in the 3,000 gal./day.

Water Balance: Treated water is discharged to the Swift Creek Mine system. Water use is included in the balance shown in Table A1.2-1 as MGD and in Table A1.2-2 as GPM.

Water Treatment: A Florida permit 0024-2525 was issued 8-19-75. One permit was granted 1-22-76 for construction of a septic tank for the mobile shop by Hamilton County of the state of Florida. The allowable effluent limitations in Florida are 90 percent treatment or better. The actual effluent was as follows:

Tests 6-10-75, 7-10-75, 7-14-75

D.O.: 5-7 ppm

pH: 7.2-7.6

Chlorine, resid.: 2.5-3.02 ppm

BOD: 3-5 ppm, 96.6 percent to 98 percent removal

TSS: 0.05-2 ppm, 98.3 percent to 99.5 percent removal

A1.2.4.2 Fresh Water Supply--Existing

This plant has an existing fresh water supply. The source is from deep wells. There are no permits. A description of the wells is given in Table A1.2-12. The water balance is included in Tables A1.2-1 and 2 and the available well analyses are given in Tables A1.2-13 and 14.

A1.2.4.3 Electric Power

Electric power will be supplied by Florida Power Corporation.

A1.2.4.4 Boilers

Two very small boilers are used in the flotation plant for process heating purposes. These boilers produce approximately 2,000 lb/hr of 50 psig steam. One boiler is operated most of the year and the second is operated approximately four months out of the year.

A1.2.4.5 Chemicals and Reagents

The chemicals and reagents used include: (1) small amounts of acid and base for pH adjustment; (2) fatty acids and amines for flotation; (3) kerosene for flotation; (4) water treatment chemicals for two very small

boilers used for fuel oil and process heating; and (5) chlorine for sewage water treatment. The chemical and reagent used is approximately 17 lb/ton of concentrate produced.

Table A1.2-1 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Swift Creek Mine-Overall Balance (Recycle
 Within Mine Circuit is 206.4 MGD or 95.4 percent
 Recycle)

	In	MGD Out
Well Water	9.67	
Rainfall	3.88	
Vent Air (including combustion water)	0.02	
Mine Seepage Water into Cut	1.40	
Wet Matrix Water	2.52	
Solar Evaporation		3.88
Deposited Water with Clays		7.58
Deposited Water with Tailings		0.86
Deposited Water with Mud Balls		0.43
Mine Discharge to Surface Waters		4.65
Water in Wet Rock Product		0.10
Water in Dry Rock Product		0.01
Scrubber Stack		0.05
Sanitary & Regeneration Water from SCCC	0.07	
TOTAL OVERALL BALANCE	17.56	17.56

Table A1.2-2 Water Summary (Based on 365 DPY Operating Time)
 -GPM-Swift Creek Mine-Overall Balance (Recycle
 Within Mine Circuit is 140,000 GPM or 95.4 percent
 Recycle)

	In	GPM Out
Well Water	6,714	
Rainfall	2,697	
Vent Air (including combustion water)	11	
Mine Seepage Water into Cut	973	
Wet Matrix Water	1,749	
Solar Evaporation		2,696
Deposited Water with Clays		5,265
Deposited Water with Tailings		599
Deposited Water with Mud Balls		303
Mine Discharge to Surface Waters		3,227
Water in Wet Rock Product		67
Water in Dry Rock Product		8
Scrubber Stack		32
Sanitary & Regeneration Water from SCCC	53	
TOTAL OVERALL BALANCE	12,197	12,197

Table A1.2-3 Water Summary (Based on 365 DPY Operating Time
-MGD-Swift Creek Mine-Mine Cut

	In	MGD	Out
MINE CUT:			
Recycle Water from Settling Ponds	14.79		
Mine Seepage	1.40		
Wet Matrix	2.52		
Matrix Slurry Water			18.71
TOTAL MINE CUT	18.71		18.71

Table A1.2-4 Water Summary (Based on 365 DPY Operating Time
-GPM-Swift Creek Mine-Mine Cut

	In	GPM	Out
MINE CUT:			
Recycle Water from Settling Ponds	10,270		
Mine Seepage	973		
Wet Matrix	1,749		
Matrix Slurry Water			12,992
TOTAL MINE CUT	12,992		12,992

Table A1.2-5 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Swift Creek Mine-Beneficiation Plant

	In	MGD Out
BENEFICIATION PLANT:		
Recycle Mine Water	184.86	
Recycle to Settling Ponds		204.27
Sanitary Water & Regeneration Water from SRCC	0.07	
Well Water	9.67	
Matrix Slurry Water	18.71	
Wet Rock to Dryer Area		0.07
Wet Rock Product		0.10
Clays to Settling Pond		7.58
Tailings to Settling Pond		0.86
Mudballs to Settling Pond		0.43
TOTAL BENEFICIATION PLANT	213.31	213.31

Table A1.2-6 Water Summary (Based on 365 DPY Operating Time)
 -GPM_Swift Creek Mine-Beneficiation Plant

	In	GPM Out
BENEFICIATION PLANT:		
Recycle Mine Water	128,370	
Recycle to Settling Ponds		141,847
Sanitary Water & Regeneration Water from SRCC	53	
Well Water	6,714	
Matrix Slurry Water	12,992	
Wet Rock to Dryer Area		48
Wet Rock Product		67
Clays to Settling Pond		5,265
Tailings to Settling Pond		599
Mudballs to Settling Pond		303
TOTAL BENEFICIATION PLANT	148,129	148,129

Table A1.2-7 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Swift Creek Mine-Settling Ponds

	In	MGD Out
Rainfall	3.88	
Recycle from Beneficiation Area	204.27	
Dryer Scrubber Outlet	1.98	
Clays	7.58	
Tailings	0.86	
Mudballs	0.43	
Recycle and Discharge		206.25
Solar Evaporation		3.88
Deposited in Settling Ponds (Clays, Tailings, Mud Balls)		8.87
TOTAL SETTLING PONDS	219.00	219.00

Table A1.2-8 Water Summary (Based on 365 DPY Operating Time)
 -GPM-Swift Creek Mine-Settling Ponds

	In	GPM Out
Rainfall	2,697	
Recycle from Beneficiation Area	141,847	
Dryer Scrubber Outlet	1,379	
Clays	5,265	
Tailings	599	
Mudballs	303	
Recycle and Discharge		143,227
Solar Evaporation		2,696
Deposited in Settling Ponds (Clays, Tailings, Mud Balls)		6,167
TOTAL SETTLING PONDS	152,090	152,090

Table A1.2-9 Allowable Effluent Limitations on Existing Permits

	<u>Existing NPDES Permit</u>		<u>Existing EPA Guidelines</u>	
	Daily Av. MG/L	Daily Max. MG/L	Daily Av. MG/L	Daily Max. MG/L
TSS		90	30	60
Total Phosphorus (as P)		10		
Fluoride		10		
Ra-226			-	-
pH	6.0 - 9.0		6.0	9.0

Table A1.2-10 Water Summary (Based on 365 DPY Operating Time)
 -MGD-Swift Creek Mine-Dryer Area

	In	MGD Out
DRYER AREA:		
Mine Water to Dryer Scrubbers	1.95	
Vent Air (including fuel combustion water)	0.02	
Wet Rock Feed	0.07	
Dry Rock Product		0.01
Stack		0.05
Dryer Scrubber Outlet Recycle to Pond Area		1.98
TOTAL DRYER AREA	2.04	2.04

Table A1.2-11 Water Summary (Based on 365 DPY Operating Time)
 -GPM-Swift Creek Mine-Dryer Area

	In	GPM Out
DRYER AREA:		
Mine Water to Dryer Scrubbers	1,360	
Vent Air (including fuel combustion water)	11	
Wet Rock Feed	48	
Dry Rock Product		8
Stack		32
Dryer Scrubber Outlet Recycle to Pond Area		1,379
TOTAL DRYER AREA	1,419	1,419

Table A1.2-12 Description of Wells-Swift Creek Mine

Well No.	Name	Capacity Test, GPM	Depth, Feet	Casing
SC-1	Swift Creek Mine No. 1	7,000	800	26"
SC-2	Swift Creek Mine No. 2	7,000	800	26"
CD-1	Swift Creek Mine No. 1	200	240	6"
CD-2	Swift Creek Mine No. 2	30	75	4"

Table A1.2-13 Swift Creek Mine-Fresh Water Analyses

CERTIFICATE OF ANALYSIS(1)(2)			
Laboratory Marks	Potable Well SC-1	Potable Well CD-1	Potable Well CD-2
pH	6.4	7.6	7.15
Color	13	10	15
Odor	Indef.	None	None
Alkalinity	41	265	236
Total Hardness as CaCO_3	157	276	239
Total Solids	322	344	297
Total Volatile Solids	82	141	116
Fixed Solids	240	203	186
Nitrate Nitrogen ($\text{NO}_3\text{-N}$)	0.12	0.17	0.17
Sulfate (SO_4)	127	22	14
Chloride (Cl)	18	15	12
Fluoride (F)	1.6	0.36	0.38
Calcium (Ca)	62	70	66
Magnesium (Mg)	0.20	25	17
Iron (Fe)	0.60	0.06	1.1
Sodium (Na)	8.5	8.9	3.2
Potassium (K)	1.9	1.3	0.87
Non-Carbonate Hardness as CaCO_3	115	11	30
Silica (SiO_2)	74	29	30
Sodium Chloride (NaCl)	30	25	20
Hydrogen Sulfide	0.36		

(1) Thornton Laboratories, Tampa, Florida 3/4/76

(2) All analysis in parts per million except pH, color and odor

Table A1.2-14 Swift Creek Mine-Fresh Water Analyses-
Certificate of Analysis (1)

Laboratory Marks	Deep Well* SC-1	Deep Well** SC-2
Total Dissolved Solids, at 105°C.	421	360
Phenolphthalein Alkalinity, as CaCO_3	0	0
Total Alkalinity, as CaCO_3	228	228
Carbonate Alkalinity, as CaCO_3	0	0
Bicarbonate Alkalinity, as CaCO_3	228	228
Carbonates, as CO_3	0	0
Bicarbonates, as HCO_3	278	278
Hydroxides, as OH	0	0
Carbon Dioxide, as CO_2	16	12
Chloride, as Cl	0	3
Sulfate, as SO_4	48	35
Fluoride, as F	0.6	0.5
Phosphate, as PO_4	4.8	2.7
pH (Laboratory)	7.5	7.6
pHs	7.0	7.5
Stability Index	6.5	7.4
Saturation Index	0.5	0.1
Total Hardness, as CaCO_3	264	248
Calcium Hardness, as CaCO_3	180	150
Magnesium Hardness, as CaCO_3	84	98
Calcium, as Ca	72	60
Magnesium, as Mg	20	24
Sodium, as Na	13	9.4

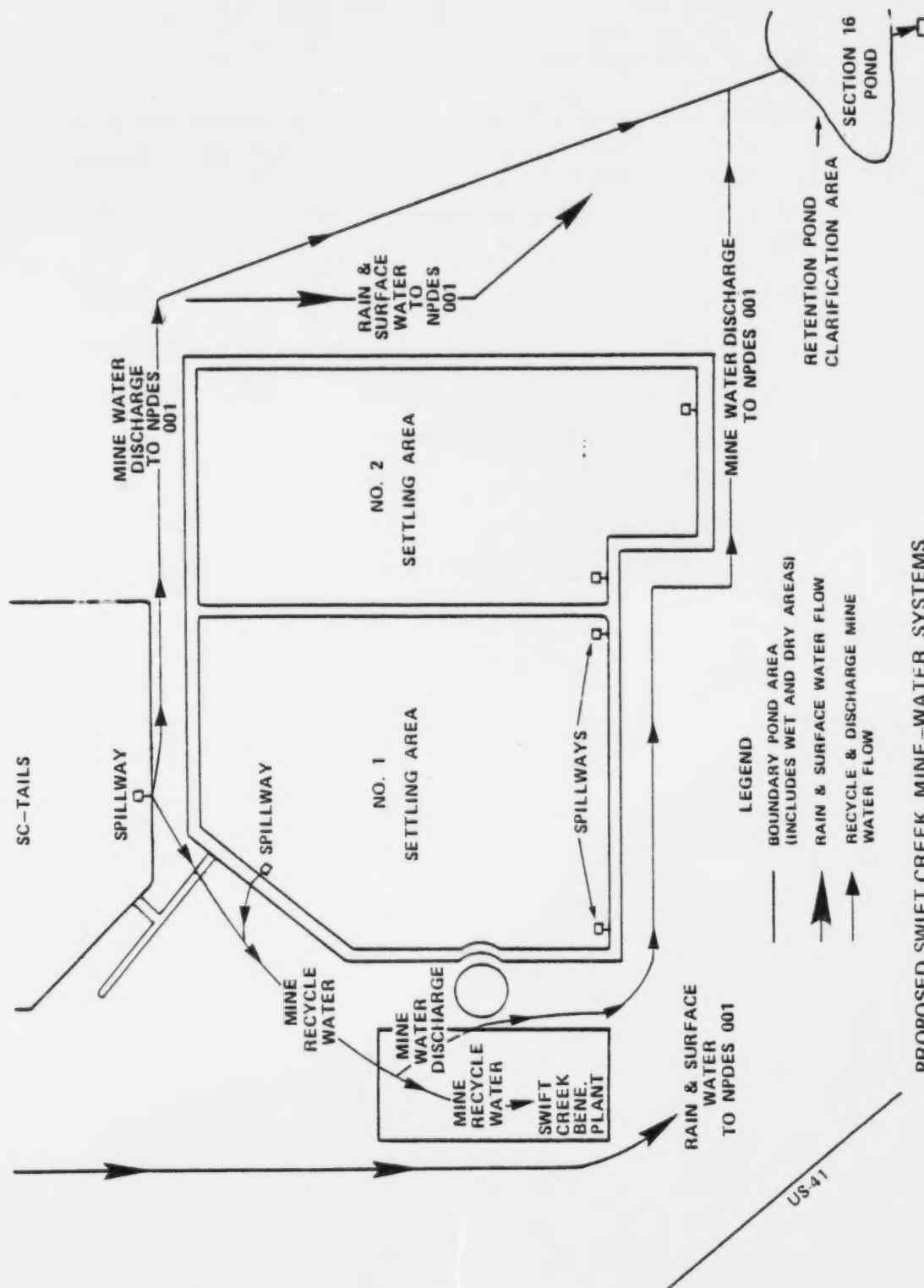
(1) All analyses in parts per million except pH, color, odor & turbidity

* Orlando Laboratories, Orlando, Florida, Nov. 15, 1974

** Orlando Laboratories, Orlando, Florida, June 30, 1975

Table A1.2-15 continued
-2-

Laboratory Marks	Deep Well* SC-1	Deep Well** SC-2
Iron, as Fe	0.1	0.2
Manganese, as Mn	0	< 0.05
Copper, as Cu	0	< 0.01
Silica, As SiO ₂	29	11
Color, Standard Platinum Cobalt Scale	6	0
Odor Threshold	0	0
Turbidity, Jackson Units	2	30



PROPOSED SWIFT CREEK MINE-WATER SYSTEMS

FIGURE A1.2-1

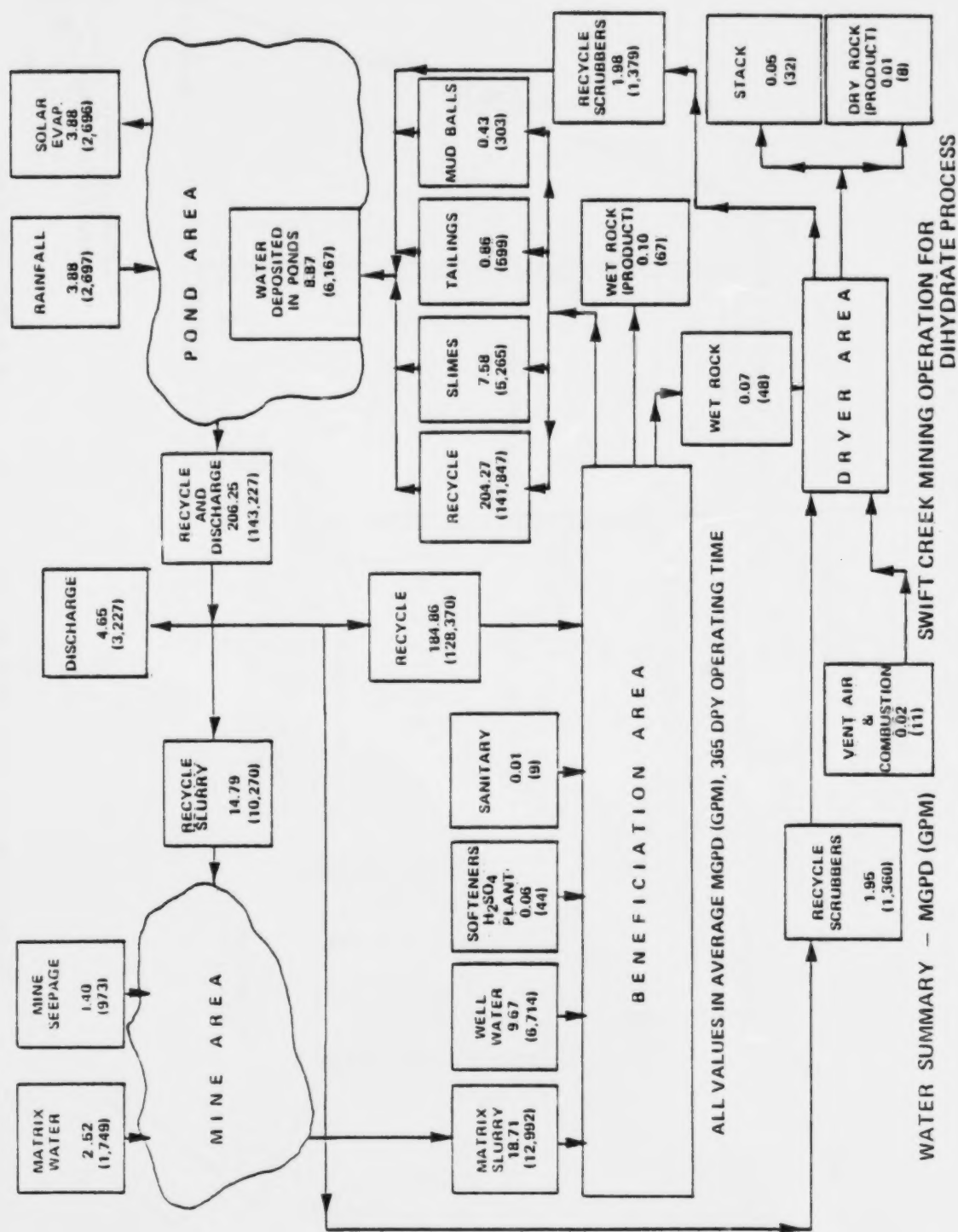
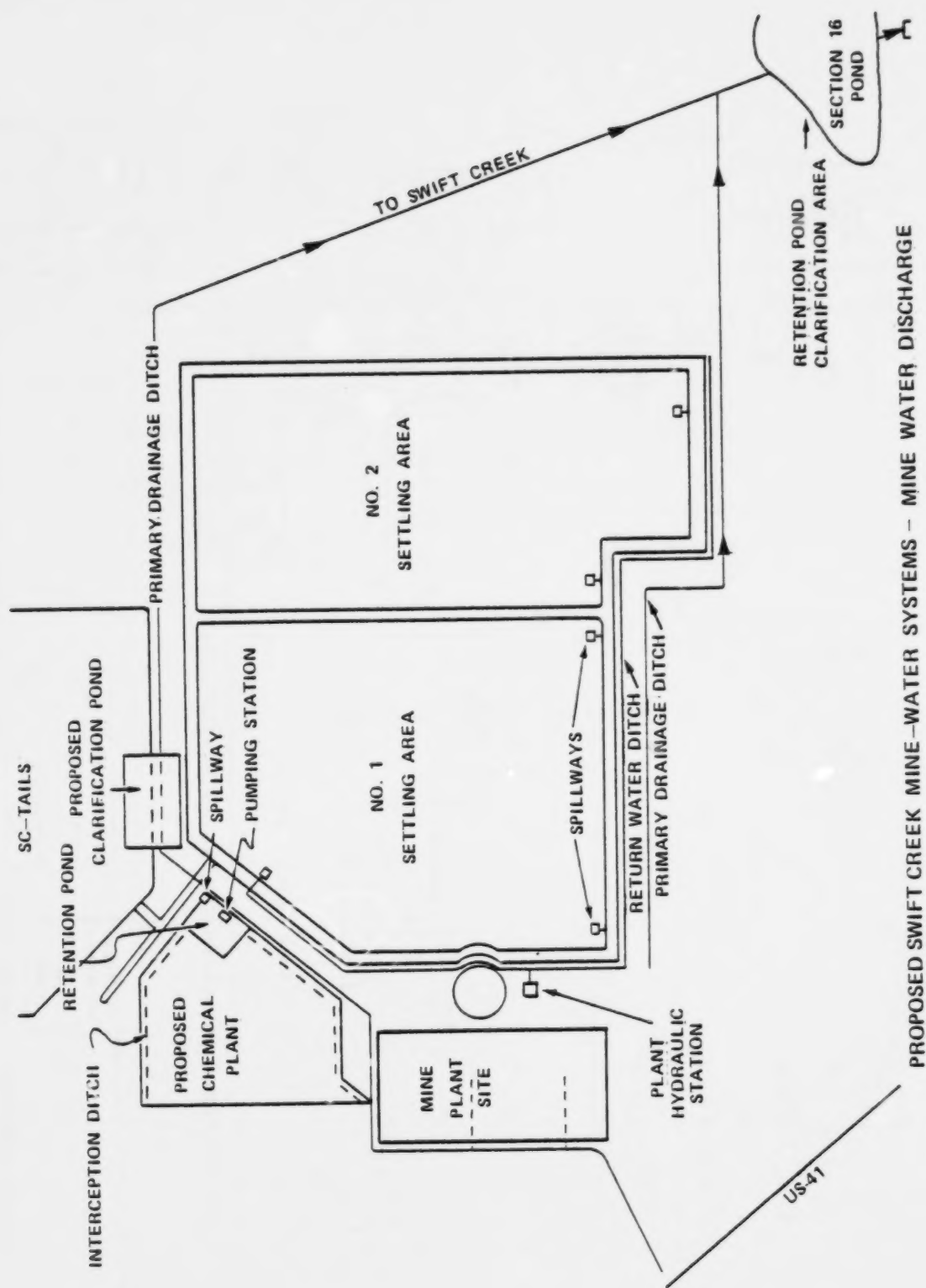
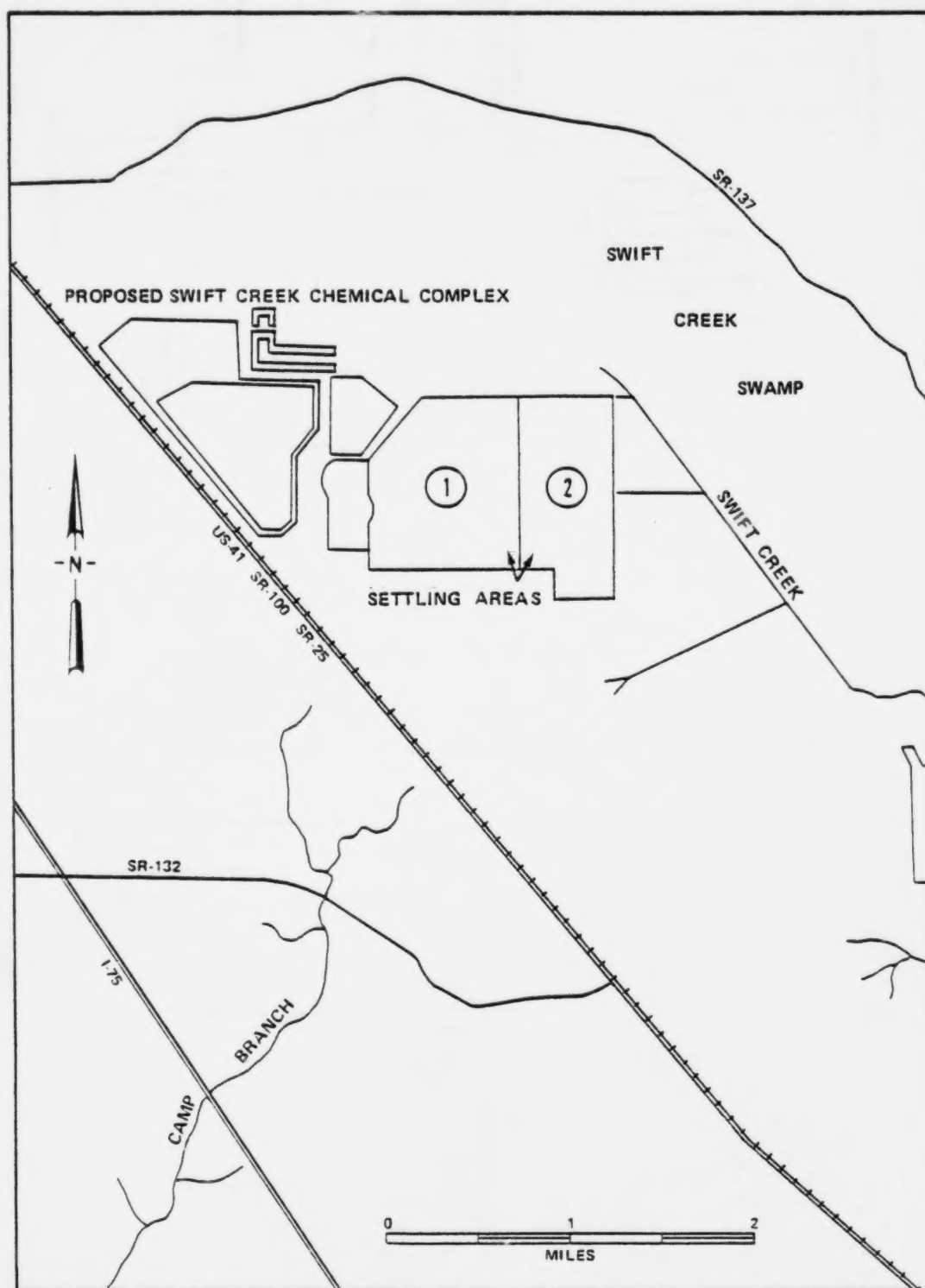


FIGURE A1.2-2



PROPOSED SWIFT CREEK MINE-WATER SYSTEMS - MINE WATER DISCHARGE

FIGURE A1.2-3



SETTLING AREA NO.2 SWIFT CREEK MINE -POND SYSTEMS

FIGURE A1.2-4

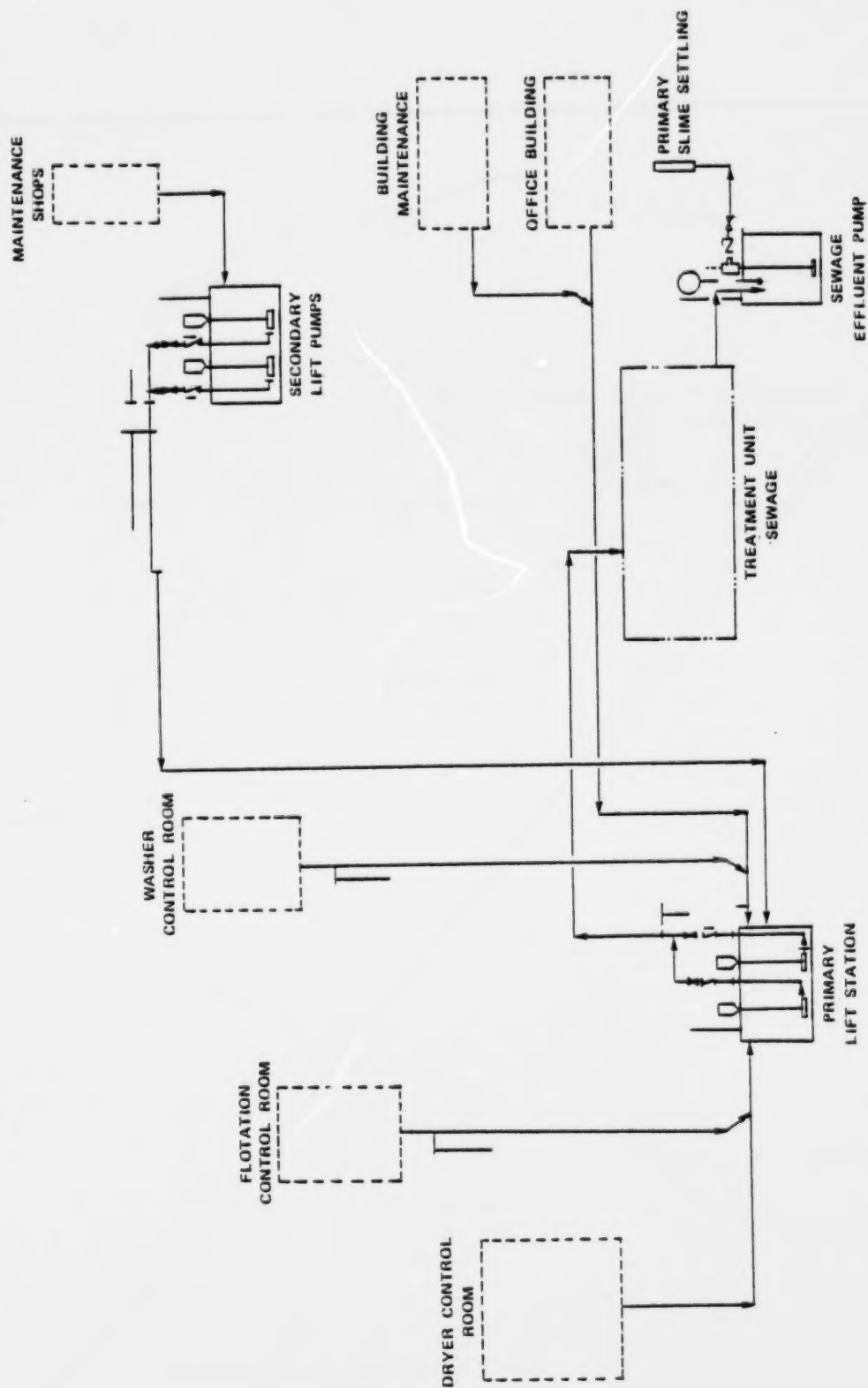


FIGURE A1.2-5

A1.2-5 REFERENCES

EPA, NPDES Monthly Reports, Form 158-R0073, January 1976 through First Quarter of 1978.

Florida, State of, Department of Environmental Regulation (FDER),
Two FDER Air Permits.

Florida, State of, Department of Environmental Regulation (FDER),
One Construction Permit from FDER.

Florida, State of, Department of Environmental Regulation (FDER),
One Mine Operating Permit from FDER.

Hamilton County, Florida, One Permit for Septic Tanks.

OXY/SPA Project Scope, Addendum

Pamphlet entitled: "Occidental Chemical Company--Florida Operations Facilities Tour, June 4, 1977, White Springs, Fla." This pamphlet was distributed during an AIME meeting held in North Florida in June, 1977.

APPENDIX
DESCRIPTION OF PROPOSED FACILITIES

A1.3 EXISTING SUWANNEE RIVER CHEMICAL COMPLEX (SRCC) FACILITIES

PLUS PHASE I EXPANSION

A1.3.1 INTRODUCTION

A1.3.1.1 Index

A1.3 EXISTING SUWANNEE RIVER CHEMICAL COMPLEX (SRCC) FACILITIES

PLUS PHASE I EXPANSION

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A1.3.3 DESCRIPTION & ENVIRONMENTAL ASPECTS OF EXISTING PROCESS

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A1.3.3.1 Sulfuric Acid Plants A&B

A1.3.3.2 Sulfuric Acid Plants C&D

A1.3.3.3 Phosphate Rock Transport & Grinding

A1.3.3.3.1 Phosphate Rock Transport Plant No. 1
and Grinding Plants 1 and 2

A1.3.3.3.2 Phosphate Rock Transport Plant No. 2

A1.3.3.4 Phosphoric Acid Plant A (Dorr-Oliver Plant)

A1.3.3.5 Phosphoric Acid Plant B (Prayon Plant)

A1.3.3.6 Phosphoric Acid Plant C (OXY Plant)

A1.3.3.7 Granular Triplesuperphosphate Plant
(GTSP) (Dorr-Oliver)

A1.3.3.8 Diammonium Phosphate Plant No. 1
(DAP) (Dorr-Oliver)

A1.3.3.9 Diammonium Phosphate Plant No. 2
(DAP) (Badger)

A1.3.3.10 Superphosphoric Acid Plants No. 1 & No. 2

A1.3.3.11 Polyphos Plant, Storage and Shipping

A1.3.3.12 GTSP Storage & Shipping Building No. 1

A1.3.3.13 GTSP Storage Building No. 2

A1.3.3.14 DAP Storage, Screening, and Shipping

A1.3.3.15 Solvent Extraction Pilot Plant (S-X)

A1.3.4 DESCRIPTION & ENVIRONMENTAL ASPECTS OF NEW PROCESS

UNITS - SRCC

A1.3.4.1 Phosphoric Acid Clarification

A1.3.4.2 54 Percent Phosphoric Acid Evaporation

A1.3.4.3 Superphosphoric Acid Plants A&B

A1.3.5 DESCRIPTION & ENVIRONMENTAL ASPECTS OF AUXILIARY SUPPORT

FACILITIES - SRCC

A1.3.5.1 No. 1 Gypsum Stack & Cooling Ponds - Existing

A1.3.5.2 No. 2 Gypsum Stack & Cooling Ponds - Existing

A1.3.5.3 Nonprocess Water Treatment

A1.3.5.4 Domestic Water Treatment Plants - Existing

A1.3.5.5 Fresh Water Supply - Existing

A1.3.5.6 Process Chemicals

A1.3.5.6.1 Defoamer

A1.3.5.6.2 Inorganic Chemicals

A1.3.5.6.3 Limestone and Lime

A1.3.5.7 Electric Power

A1.3.6 REFERENCES

A1.3.1.2 List of Figures

A1.3-1 Water Summary - MGD - Suwannee River Chemical Complex

A1.3-2 Water Summary - GPM - Suwannee River Chemical Complex

A1.3-3 Water Systems - Suwannee River Chemical Complex

A1.3.1.3 List of Tables

A1.3-1 Water Summary (Based on 310 DPY Operating Time) - MGD -
Suwannee River Chemical Complex - Overall Balance on Complete
Complex

A1.3-2 Water Summary (Based on 310 DPY Operating Time) - GPM -
Suwannee River Chemical Complex - Overall Balance on Complete
Complex

A1.3-3 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Sulfuric Acid Plants A&B

A1.3-4 Water Summary (Adjusted to 310 DPY Operation to Conform with
Phosphate Units) - Suwannee River Chemical Complex - Sulfuric
Acid Plants C&D

- A1.3-5 Water Summary (Based on 310 DPY Operating Time) -
Suwannee River Chemical Complex - Phosphate Rock Grinding
- A1.3-6 Water Summary (Based on 310 DPY Operating Time) -
Suwannee River Chemical Complex - Phosphate Rock
Transport No. 2
- A1.3-7 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Phosphoric Acid Plant A
(Dorr-Oliver)
- A1.3-8 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Phosphoric Acid Plant B (Prayon)
- A1.3-9 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Phosphoric Acid Plant C (OXY)
- A1.3-10 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Granular Triplesuperphosphate
Plant
- A1.3-11 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Diammonium Phosphate Plant No. 1
- A1.3-12 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Diammonium Phosphate Plant No. 2
- A1.3-13 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Ammonia Storage Area
- A1.3-14 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Polyphos Plant
- A1.3-15 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - GTSP Storage & Shipping No. 1 &
No. 2 & DAP Storage & Shipping

- A1.3-16 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Clarification
- A1.3-17 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - 54% P_2O_5 Evaporation
- A1.3-18 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - Superphosphoric Acid Plants A&B
- A1.3-19 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - SPA Storage & Shipping
- A1.3-20 Allowable Effluent Limitations on Existing Permits
- A1.3-21 Water Treatment Effluents
- A1.3-22 Water Summary (Based on 310 DPY Operating Time) - Suwannee
River Chemical Complex - General Facilities
- A1.3-23 Description of Wells - Suwannee River Chemical Complex
- A1.3-24 Suwannee River Chemical Complex - Fresh Well Water Analyses
- A1.3-25 Process Chemicals - Sulfuric Acid Plant Boiler and Cooling
Tower Chemicals (at Rated Capacities)

A1.3.1.4 Abbreviations & Definitions

Av. - Average

BACT - Best Available Control Technology

BPL - Bone Phosphate of Lime

DAP - Diammonium Phosphate

DPY - Days per Years

F - Fluoride

GPM - Gallons (U.S.) per Minute

GTSP - Granular Triplesuperphosphate

GYP - Gypsum

H₂SO₄ - Sulfuric Acid

Lb. or Lbs. - Pound or Pounds

MGD - Millions of Gallons per Day

MG/L - Milligrams per Liter

MPA - Merchant Phosphoric Acid

MTPY - Metric Tons per Year (2,205 lbs.)

OXY - Occidental Petroleum Corporation

P₂O₅ - Phosphoric Acid

pCi/L - Picocuries per Liter

PF - Polyphos

ppm - Parts per Million (by Wt.)

PUR - Purification

SA - Sulfuric Acid

SCM - Swift Creek Mine

SPA - Superphosphoric Acid

SPF - Specialty Phosphate Fertilizers

SRCC - Suwannee River Chemical Complex

SRM - Suwannee River Mine

STPH - Short Tons per Hour (2,000 lbs.)

STPY - Short Tons per Year (2,000 lbs.)

S-X - Solvent Extraction

' - Feet

" - Inches

A1.3 EXISTING SUWANNEE RIVER CHEMICAL COMPLEX (SRCC) FACILITIES PLUS PHASE I EXPANSION AT SUWANNEE RIVER CHEMICAL COMPLEX

A1.3.1 INTRODUCTION

Operation of the existing Suwannee River Chemical Complex (SRCC) began in the fall of 1966 with the production of sulfuric acid (SA), granular triplesuperphosphate (GTSP), diammonium phosphate (DAP), superphosphoric acid (SPA), and merchant phosphoric acid (MPA), and by-product gypsum (GYP), based on a wet process phosphoric acid production capability of 220,000 STPY P_2O_5 . A defluorinated phosphate rock animal feed ingredient unit (Polyphos) was added in 1970. In 1975, an expansion was completed to increase wet phosphoric acid production capacity to the present level of 550,000 short tons per year.

Engineering for Phase I of the Russian SPA project (as an "expansion" of SRCC) started in April 1977, construction in August 1977. Start-up is planned for October 1978.

SRCC is located in Hamilton County in North Florida, on a level plot of about 120 acres, north of White Springs, Florida; and east of State Road 137, which intersects U.S. Highway 41 between White Springs and Jasper, Florida, as shown on Figure 1.4-1. UTM coordinates are E328320, N3368820.

A1.3.2. CHEMICAL PLANT DESCRIPTION

A1.3.2.1 Products

Final products are SA, GTSP, DAP, SPA, MPA and Polyphos. Some by-product gypsum is shipped from the Chemical Complex for use as a soil conditioner. The gypsum has a Ra-226 content of 14 pCi/g compared to a phosphate rock

content of rate of 18 pCi/g (Table 3.5-1-Summary Document). Ground phosphate rock was used extensively in the past as a slow release fertilizer.

A1.3.2.2 Capacity

Capacity of the SRCC is 550,000 short tons per year of P_2O_5 as wet process phosphoric acid used in the production of the final products. Sufficient sulfuric acid will be produced on-site to satisfy requirements. Phosphate rock will be supplied from the existing (and adjacent) Suwannee River Mine (SRM).

A1.3.2.3 Raw Materials

Sulfur, ammonia, and caustic soda will be supplied by rail car, by truck, and phosphate rock by conveyor belt.

A1.3.2.4 Process Units

Intermediates and final products will be processed or produced on-site using the existing facilities which consist of a phosphate rock grinding plant, three wet process phosphoric acid plants, four contact sulfuric acid plants, a GTSP plant, two DAP plants, and a Polyphos plant. New facilities to be added in Phase I consist of a phosphoric acid clarification plant and two SPA evaporators. Two existing SPA plants will be idled and a solvent extraction (S-X) pilot plant may be operated a few weeks per year.

A1.3.2.5 Auxiliary & Support Facilities

Existing support facilities at the Suwannee River Chemical Complex consist of administrative offices, a central laboratory, a maintenance shop, a supplies warehouse, product storage and shipping facilities, two gypsum stacks with associated cooling ponds, fuel oil and miscellaneous

chemicals storage, electric power substations, roads, railroads, deep freshwater wells, domestic sewage treatment plants, compressed air, interconnecting piping (for raw materials, intermediates, products, potable water, fresh water, cooling water, steam, reagents), a fire water system, a single-stage lime treatment station, a two-stage lime treatment stations, and two auxiliary boilers.

A1.3.2.6 Water Balance

The Suwannee River Chemical Complex has three 5,000 gallons per minute (gpm) freshwater wells at depths of 700 ft, 800 ft, and 803 ft. Two wells are normally operated and one is a spare.

Two 200 gpm potable wells at depths of 248 ft and 315 ft supply all potable water uses. Treated domestic water is discharged to the Suwannee River Mine (SRM) circuit.

Detailed water balances were prepared for each process unit and support facility of the existing Suwannee River Chemical Complex. The balances include planned operations with Phase I in operation and are based on Occidental Chemical Company's project scope; process flowsheets; product slate and tonnages; material balances; process unit operating sequences; raw material, intermediate, and product specifications; performance tests of air pollution control equipment; equipment specifications; plant reports; aerial photographs of two gypsum stacks and cooling ponds (to scale); local weather data; and other information.

An overall water balance is summarized in Figure A1.3-1 and Table A1.3-1 for the Suwannee River Chemical Complex plus Phase I in terms of MGD (millions of gallons of water per day). Figure A1.3-2 and Table A1.3-2 present the same data as gallons per minute. All are based on an operating time of 310 days per year (DPY).

Fresh water requirements are 12.0 MGD (8,341 gpm) and nonprocess water discharge is 8.31 MGD (5,773 gpm). No. 1 gypsum stack and cooling pond shows a deficit water balance of 0.15 MGD (102 gpm) and No. 2, 0.55 MGD (383 gpm). The systems are interconnected so that process water may be transferred from either system to the other if required to maintain surge volume without neutralization and discharge.

A1.3.2.7 Water Discharges

Water discharge routes are shown on Figure A1.3-3 which is based on an aerial photograph of the existing Suwannee River Chemical Complex.

Nonprocess water discharges flow north from the chemical complex site, then west to the freshwater ditch, then south to the nonprocess surge pond of 29.3 acres prior to discharge south to intercept Swift Creek.

Rainfall runoff from the Suwannee River Chemical Complex flows into the freshwater ditch from most of the plant site. Rainfall from the southern portion of the plant site drains south between the No. 1 cooling pond and No. 1 gypsum stack to intercept Swift Creek.

Process water was not discharged during the period from January 1976 through January 1978. In February 1978 intermittent periods of process water treatment and discharge were initiated. When discharged, process water is treated in a two-stage neutralization system using limestone and lime and settled in ponds (No. 1 and No. 2) after each stage of treatment. Discharge of treated water flows from the southwest corner of pond No. 2 to intercept the rainfall runoff ditch leaving the southern portion of the plant site.

NPDES discharge point 001 (see Figure A1.3-3) is in Swift Creek about 2.2 miles (3.7 km) south of the southwest corner of the Suwannee River Chemical Complex plant site.

Actual flows at EPA discharge point 001 for permit FL0000655 located in Swift Creek from January 1976 through September 1977 are shown in Figure 1.4-5. These flows include the Suwannee River Chemical Complex discharges plus the Suwannee River Mine (SRM) and Swift Creek Mine (SCM) and rainfall runoff; therefore, they cannot be correlated directly with past chemical plant operation or future planned operation at the completion of Phase I. During this period, average flows (based on daily measurements) ranged from 4.0 MGD in May 1977 to 146 MGD in February 1976, with daily flows ranging from zero in May 1976 to 188.5 MGD in March and April 1976. This compares with average calculated nonprocess water discharge rates of 7.06 MGD for 365 days per year after the completion of Phase I with simultaneous operation at planned capacities for all process units.

A1.3.2.8 Process Water Surge Levels

A1.3.2.8.1 No. 1 Cooling Pond and Surge Pond

The No. 1 process water cooling pond and surge pond have a water area of 168.9 acres and must contain a water surge for a 10-year, 24-hour rainfall (existing source), as a minimum, or 7 inches of rainfall (Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May 1961). Total rainfall area for the No. 1 gypsum stack, No. 1 cooling pond, and No. 1 surge pond is 329.5 acres, so that the 10-year, 24-hour rainfall of 7 inches would raise the pond level by:

$$\frac{(329.5 \text{ acres})(7/12 \text{ ft})}{168.9 \text{ acres}} = 1.14' \text{ or } 1'-1-3/4''$$

The actual surge in the cooling pond and surge pond allows for 1.5 ft in the cooling pond and 3.0 ft in the surge pond between average water level and the maximum level. This is more than required for the 10-year 24-hour rainfall and would contain the 25-year rainfall.

A1.3.2.8.2 No. 2 Cooling Pond and Surge Pond

The No. 2 process water-cooling pond and surge pond have a water area of 200 acres and were designed to contain a water surge for a 25-year, 24-hour rainfall (existing source) which is 8 inches of rainfall (Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May 1961). Total rainfall area for the No. 2 gypsum stack, No. 2 cooling pond, and No. 2 surge pond is 461.7 acres so that the 25-year, 24-hour rainfall of 8 inches would raise the pond level by:

$$\frac{(461.7 \text{ acres})(8/12 \text{ ft})}{200 \text{ acres}} = 1.54' \text{ or } 1'-6-1/2''$$

The actual surge in the cooling pond and surge pond allows for 2 feet between the average water level. This contains the 25-year, 24-hour rainfall.

A1.3.2.9 Permits

The Suwannee River Chemical Complex has numerous water and air operating permits for the existing operation and air construction permits for the Phase I expansion now underway.

Water permits consist of one EPA NPDES permit and five Florida permits, including two permits for domestic water treatment plants. EPA has proposed a revised NPDES permit; held a public hearing on February 9, 1978, in White Springs, Florida; and a revised permit is to be issued.

Air permits consist of 26 Florida operating permits for the existing operations and four Florida construction permits for the Phase I expansion. The operating permits have been reviewed as well as recent test data for the pollution control equipment. Based on test data, all emissions meet permit requirements.

A1.3.3 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF EXISTING PROCESS UNITS AT THE SUWANNEE RIVER CHEMICAL COMPLEX

A1.3.3.1 Sulfuric Acid Plants A&B

Type of Plant: Two Dorr-Oliver sulfur burning single absorption contact sulfuric acid plants producing 93 percent sulfuric acid.

Capacity: Nominal capacity of each is 1,000 short tons per day, 100 percent sulfuric acid basis; auxiliary boiler, 50,000 lbs/hr, 250 psig saturated: fuel will be 0.8 percent sulfur, commercial distillate.

Raw Materials: Molten sulfur, water, and air.

Storages: (1) Two 4,500 ton (100 percent basis) 93 percent sulfuric acid storage tank; (2) two 2,300 ton molten sulfur storage tanks; and (3) one fuel oil tank with capacity of 9,467 gallons.

Air Emissions: Plant A has a Florida permit A024-2462--issued 9-5-75 which expires 8-31-80 and Plant B has a Florida Permit A024-2467--issued 9-15-75 which expires 8-31-80. The allowable air emission on the existing Florida permits for Plants A&B is 29 lb SO₂ ton H₂SO₄ produced (100 percent basis) according to FDPC rule change.

Water Discharges: Only nonprocess water is discharged from the plants. Boiler blowdown, cooling tower blowdown, miscellaneous cooling water (for bearings, air compressors, air conditioner, and oil cooling), condensate from the sulfur melting coils, and rainfall run-off are discharged to the freshwater ditch. Water from regeneration of the boiler feed water softeners is discharged to the Suwannee River Mine water circuit north of the Suwannee River Chemical Complex. Table A1.3-3 summarizes water uses and discharges.

A1.3.3.2 Sulfuric Acid Plants C&D

Type of Plant: Two Parsons sulfur burning double absorption contact sulfuric acid plants producing 98 percent and 93 percent sulfuric acid.

Capacity: Nominal capacity of each is 1,800 short tons per day, 100 percent sulfuric acid basis; auxiliary boiler, 115,000 lbs/hr, 600 psig, 600°F; fuel will be 0.8 percent sulfur, commercial distillate.

Raw Materials: Molten sulfur, water, and air.

Storages: (1) Three 5,267 ton (100 percent basis) 93 percent sulfuric acid storage tanks; (2) one 6,300 ton molten sulfur storage tank; (3) one fuel oil storage tank with capacity of 50,000 gal; and (4) one caustic soda storage tank with capacity of 37,580 gal.

Air Emissions: Plant C has a Florida Permit A024-2548--issued 3-1-76 which expires 1-31-80 and Plant D has Florida Permit A024-2485--issued 10-9-75 which expires 9-30-80. The allowable air emission on the existing Florida permits for Plant C is 4.0 lb SO_4 /ton H_2SO_4 produced (100 percent basis) and for Plant D, 4.0 lb SO_2 /ton H_2SO_4 produced (100 percent basis), 0.15 lb sulfuric acid mist/ton H_2SO_4 produced (100 percent basis).

Water Discharges: Only nonprocess water is discharged from the plants. Boiler blowdown, cooling tower blowdown, miscellaneous cooling water

(for bearings, air compressor, air conditioner, and oil systems), condensate from the sulfur melting coils, and rainfall run-off are discharged to the freshwater ditch. Water from regeneration of the boiler feed water softeners is discharged to the Suwannee River Mine water circuit north of the Suwannee River Chemical Complex. Table A1.3-4 summarizes water uses and discharges.

A1.3.3.3 Phosphate Rock Transport and Grinding

A1.3.3.3.1 Phosphate Rock Transport Plant No. 1 and Grinding Plants 1&2

These plants supply Phosphoric Acid Plant A, Granular Triplesuperphosphate Plant, and Polyphos Plant.

Type of Plant: A 30-in. wide conveyor belt from the mine delivers dry ground rock to the rock grinding plants which consist of an unground rock silo, two ball mills, ground rock silos, and a pneumatic conveying system.

Capacity: A 30-in. wide conveyor belt with nominal 750 short tons per day capacity. Ball Mill No. 1 has a 2,000 STPD capacity for primary rock and 75 STPH for secondary rock. Ball Mill No. 2 has a 960 STPD capacity for primary rock.

Raw Materials: 68 bone phosphate of lime (BPL) dry unground phosphate rock for phosphoric acid plant A and 72 BPL dry ground phosphate rock for GTSP and Polyphos Plant.

Storages: The 68 BPL unground rock bin 2,120 tons; the 68 BPL ground rock bin 625 tons; 72 BPL unground rock bin 1,302 tons; 72 BPL ground rock bins 1,113 tons and 986 tons.

Air Emissions: Grinding Plant No. 1 has a Florida Permit A024-2331 Grinding Plant No. 2, Permit A024-2234 both currently in force. The allowable air emissions for the existing Florida permits for Plant No. 1 particulates is 34.9 lb/hr, and for Plant No. 2, particulate is 31.0 lb/hr.

Water Discharges: Only nonprocess water is discharged from the plants. Bearing cooling water and rainfall run-off is discharged to the freshwater ditch. Table A1.3-5 summarizes water uses and discharges.

A1.3.3.3.2 Phosphate Rock Transport Plant No. 2

This plant supplies phosphoric acid plants B&C.

Type of Plant: A 30-in. wide conveyor belt from the mine will be modified to handle wet rock for these plants (as well as dry rock) and will discharge to a 24-in. belt conveyor to silo to a 24-in. belt conveyor to rock surge bin at Phosphoric Acid Plants B&C.

Capacity: A 24-in. wide conveyor belt with 400 short tons per hour nominal capacity.

Raw Materials: Wet unground 68 BPL rock.

Storages: A 3,880-ton concrete silo modified for wet rock storage.

Air Emissions: No air emissions will occur in the conveying and storage of wet phosphate rock; therefore, particulate collection devices and air permits will not be required.

Water Discharges: Water from belt sprays and dewatering of wet rock in the 3,880-ton concrete silo will be discharged to the Suwannee River Mine water circuit east of the Suwannee River Chemical Complex. Table A1.3-6 summarizes water uses and discharges.

A1.3.3.4 Phosphoric Acid Plant A (Dorr-Oliver Plant)

Type of Plant: Dorr-Oliver wet process dihydrate phosphoric acid plant with Bird Prayon tilting pan filter, three forced circulation type evaporators, and tank farm.

Capacity: Nominal capacity 650 short tons per day P_2O_5 .

Raw Materials: Dry ground 68 BPL phosphate rock, 93 percent sulfuric acid and water.

Storages: (1) Eight storage tanks for phosphoric acid storage from 28 percent P_2O_5 to 48 percent P_2O_5 with total volume of 4,440,000 gal. and (2) One defoamer tank with capacity of 11,150 gal.

Air Emissions: Phosphoric Acid Plant A has Florida permit A024-2325 currently in force. The allowable air emission for the existing Florida permit is: Fluorides at 0.4 lb F/ton P_2O_5 input (complex) and 0.75 lb/hr is allocated this plant at 650 tons per day P_2O_5 and particulates at 40 lb/hr.

Water Discharges: Only nonprocess water and used well water is discharged continuously. Process water is recirculated from the No. 1 Gypsum Stack and Ponds, except when treatment of excess water is required. Nonprocess water and rainfall run-off consisting of vacuum pump seal water, filter vacuum scrubbers, evaporator condensate, and filter skirt sprays is discharged to the freshwater ditch. Table A1.3-7 summarizes water uses and discharges.

A1.3.3.5 Phosphoric Acid Plant B (Prayon Plant)

Type of Plant: Prayon wet process dihydrate phosphoric acid plant with two Bird-Prayon tilting pan filters, three forced circulation type evaporators, and tank farm.

Capacity: Nominal capacity 777.5 short tons per day P_2O_5 .

Raw Materials: Wet unground 68 BPL phosphate rock and 93 percent sulfuric acid.

Storages: Two storage tanks for phosphoric acid storage at 28 percent P_2O_5 and 40 percent P_2O_5 with total volume of 600,000 gal.

Air Emissions: Phosphoric Acid Plant B has a Florida Permit A024-2486 currently in force. The allowable air emission for the existing Florida permit is: Fluorides at 0.02 lb F/ton P_2O_5 input; particulates at 36.5 lb/hr; and opacity, 20 percent.

Water Discharges: Only nonprocess water and used well water is discharged continually. Process water is recirculated from the No. 2 Gypsum Stack and Ponds, except when treatment of excess water is required.

Nonprocess water and rainfall run-off consisting of vacuum pumps seal water, filter skirt sprays, and miscellaneous cooling water (for air compressors and oil coolers) is discharged to the freshwater ditch.

Table A1.3-8 summarizes water uses and discharges.

A1.3.3.6 Phosphoric Acid Plant C (Occidental Plant)

Type of Plant: Occidental proprietary wet process hemihydrate phosphoric acid plant with vacuum filter, two forced circulation type evaporators, and tank farm.

Capacity: Nominal capacity, 350 short tons per day P_2O_5 .

Raw Materials: Wet unground 68 BPL phosphate rock and 98 percent sulfuric acid.

Storages: (1) Two storage tanks for phosphoric acid storage for 40 percent P_2O_5 with total volume of 600,000 gal. and (2) One defoamer tank with capacity of 11,500 gal.

Air Emissions: Phosphoric Acid Plant C has a Florida permit A024-2491 currently in force. The allowable air emission for the existing Florida permit is as follows: Fluorides at 0.02 lb F/ton P_2O_5 input; particulates at 32.6 lb/hr; and opacity, 20 percent.

Water Discharges: Only nonprocess water and used well water is discharged continuously. Process water is recirculated from the No. 2 Gypsum Stack and Ponds, except when treatment of excess water is required. Nonprocess water consisting of vacuum pumps seal water is discharged to the freshwater ditch. Table A1.3-9 summarizes water uses and discharges.

A1.3.3.7 Granular Triplesuperphosphate Plant (Dorr-Oliver)

Type of Plant: Direct slurry type granulation plant to produce GTSP from phosphate rock and phosphoric acid using pug mills for granulation.

Capacity: Nominal capacity is 600 short tons per day GTSP.

Raw Materials: (1) Dry ground phosphate rock, 72 BPL and (2) 40 percent - 48 percent P_2O_5 wet process phosphoric acid.

Storages: Three phosphoric acid storage tanks with a total volume of 315 tons acid P_2O_5 .

Air Emissions: The Granular Triplesuperphosphate Plant (GTSP) has a Florida Permit A024-2326 currently in force. The allowable air emission for the existing Florida permit is as follows: Fluorides at 0.4 lb F/ton P_2O_5 input (complex), 4.17 lb F/hr is allocated to this plant at 30 tons per hour GTSP and particulates at 45.9 lb/hr.

Water Discharges: Only nonprocess water and used well water is discharged continuously. Process water is recirculated from the No. 1 Gypsum Stack and Ponds except when treatment of excess water is required. Nonprocess water used for cooling air compressor is discharged to the freshwater ditch. Table A1.3-10 summarizes water uses and discharges.

A1.3.3.8 Diammonium Phosphate Plant No. 1 (Dorr-Oliver)

Type of Plants: Direct slurry-type granulation plants are used to produce diammonium phosphate with a preneutralizer and using pug mills for granulation.

Capacity: Nominal capacity is 600 short tons per day of DAP.

Raw Materials: (1) Dry ground 72 BPL phosphate rock, (2) 30 percent-54 percent P_2O_5 wet process phosphoric acid, and (3) anhydrous ammonia.

Storages: (1) Three phosphoric acid storage tanks with a total volume of 315 tons acid P_2O_5 ; (2) anhydrous ammonia bullet tank with a storage capacity of 200 tons NH_3 and an ammonia sphere with a storage capacity of 2,000 tons NH_3 ; and (3) one sulfuric acid storage tank with a capacity of 9,000 gal.

Air Emissions: The Diammonium Phosphate Plant No. 1 (DAP) has a Florida permit A024-2327 currently in force. The allowable air emission for the existing Florida permit is as follows: Fluorides at 0.4 lb F/ton P_2O_5 input (complex) -- 4.17 lb F/hr was allocated this plant at 30 tons per hour DAP and particulates at 45.8 lb/hr.

Water Discharges: Only nonprocess water and used well water is discharged continuously. Process water is recirculated from the No. 1 Gypsum Stack and Ponds, except when treatment of excess water is required. Nonprocess water used for cooling air compressors, steam condensate, and oil cooling is discharged to the freshwater ditch. Table A1.3-11 summarizes water uses and discharges.

A1.3.3.9 Diammonium Phosphate Plant No. 2 (Badger)

Type of Plant: A Badger Granular DAP Plant with preneutralizer and pug mills for granulation.

Capacity: Nominal capacity is 1200 short tons per day.

Raw Materials: (1) 30 Percent - 50 Percent P_2O_5 wet process phosphoric acid and (2) anhydrous ammonia.

Storages: (1) two phosphoric acid storage tanks with a total volume of 210 tons of acid P_2O_5 ; (2) anhydrous ammonia "bullet tank" with a storage capacity of 2,000 tons NH_3 ; and (3) three fuel oil tanks with a total storage capacity of 54,000 gal.

Air Emissions: The Diammonium Phosphate Plant No. 2 has a Florida Permit A024-2480 currently in force. The allowable air emission on the existing Florida permit is as follows: Fluorides at 34.9 F/day (0.06 lb F/ton P_2O_5 input) and particulates at 766 lb/day.

Water Discharges: Only nonprocess water and used well water is discharged continuously. Process water is recirculated from the No. 2 Gypsum Stack and Cooling Ponds, except when treatment of excess water is required. Nonprocess water from cooling air compressor, steam condensate, and oil cooling is discharged to the freshwater ditch. Tables A1.3-12 and 13 summarize water uses and discharges.

A1.3.3.10 Superphosphoric Acid Plants No. 1 and No. 2

Note: Plants will be idle when Phase I is on-stream.

Type of Plants: Nordac submerged combustion evaporator to produce 70 percent - 72 percent P_2O_5 superphosphoric acid.

Capacity: Plant No. 1 has 300 tons per day P_2O_5 capacity and Plant No. 2 has 140 tons per day capacity.

Raw Materials: 50 percent - 54 percent P_2O_5 phosphoric acid.

Storage: For 336 tons of acid P_2O_5 .

Air Emissions: The air emission for Superphosphoric Acid Plant No. 1 has a Florida Permit A024-2329 currently in force. Plant No. 2 has a Florida Permit A024-2330 currently in force.

Water Discharges: None. Plants will be idle.

A1.3.3.11 Polyphos Plant, Storage and Shipping

Type of Plant: Defluorination of phosphate rock by Occidental proprietary fluid bed process.

Capacity: Nominal capacity is 360 short tons per day of defluorinated phosphate rock.

Raw Materials: (1) Dry unground 72 BPL phosphate rock; (2) 48 percent - 50 percent P_2O_5 wet process phosphoric acid; and (3) caustic soda.

Storages: (1) Product storage silos; (2) two phosphoric acid storage tanks with total capacity of 22,736 gal; (3) one storage tank with capacity of 37,580 gal; (4) one fuel oil tank with capacity of 42,254 gal.; and (5) one mineral oil tank with capacity of 9,000 gal.

Air Emissions: The Polyphos Plant, Storage and Shipping has a Florida Permit A024-2332 currently in force. The allowable air emission for the existing Florida permit is as follows: Fluorides at an input of 0.4 lb F/ton P_2O_5 (complex)--3.20 lb F/Hr is allocated to this plant at the rate of 17.75 short tons per hour and particulates at 30.8 lb/hr.

Water Discharges: Only nonprocess water is discharged continuously. Process cooling water is recirculated from small pond, except when excess water is overflowed to the No. 1 Gypsum Stack and Cooling Ponds system.

Nonprocess water is used for cooling air compressors, oil coolers, and air conditioners and is discharged from the freshwater ditch. Table A1.3-14 summarizes water uses and discharges.

A1.3.3.12 GTSP and Shipping Building No. 1

Type of Plant: Bulk storage building ventilated to scrubber. Material is reclaimed by payloader to bulk shipping mill to load rail cars and trucks.

Capacity: 100 short tons per hour shipping rate.

Storages: A 17,500 ton granular triplesuperphosphate storage building.

Air Emissions: The GTSP Storage and Shipping Building No. 1 has a Florida Permit A024-2328 currently in force. The allowable air emission for the existing Florida permit is: Fluorides at 0.4 lb F/ton P_2O_5 input (complex)--0.75 lb/hr F is allocated to this source and particulates at 36.17 lb/hr.

Water Discharges: Only nonprocess water is discharged continuously. Process water is recirculated from the No. 1 Gypsum Stack and Cooling Ponds except when treatment of excess water is required. Table A1.3-15 summarizes water uses and discharges for the No. 1 and No. 2 GTSP Storage Buildings and GTSP shipping and DAP storage, screening, and shipping.

A1.3.3.13 GTSP Storage Building No. 2

Type of Plant: Bulk storage building ventilates to scrubber. Material reclaimed by payloader and shipped through shipping mill in GTSP Storage Building No. 1.

Capacity: Not applicable.

Raw Materials: Granular triplesuperphosphate product.

Storages: A 17,500 ton GTSP storage building.

Air Emissions: GTSP Storage Building No. 2 has a Florida Permit A024-2479 currently in force. The allowable air emission for the existing Florida permit is as follows: Fluorides at 19.2 lb/hr F and particulates at 39 lb/hr.

Water Discharges: Only rainfall run-off is discharged. Process water is recirculated from the No. 1 Gypsum Stack and Cooling Ponds (see Table A1.3-15), except when treatment of excess water is required.

A1.3.3.14 DAP Storage, Screening, and Shipping

Type of Plant: A bulk storage building with payloader reclaim to bulk shipping mill to load rail cars and trucks.

Capacity: 200 short tons per hour shipping rate.

Raw Materials: Granular DAP product.

Storages: A 56,000 ton DAP storage building.

Air Emissions: The DAP Storage, Screening and Shipping Plant has a Florida Permit A024-2465 currently in force. The allowable air emission for the existing Florida permit is as follows: Particulates at 40.4 lb/hr.

Water Discharges: Only rainfall run-off is discharged. Dust scrubber effluent from shipping will discharge to recirculating process water circuit at DAP Plant No. 1 (see Table A1.3-15 for water summary).

A1.3.3.15 Solvent-Extraction Pilot Plant

Note: No scheduled operation. May operate intermittently.

Type of Plant: Occidental proprietary solvent extraction plant for removal of impurities from wet process phosphoric acid.

Capacity: 300 short tons per day P_2O_5 .

Raw Materials: 28% to 44% P_2O_5 wet process phosphoric acid.

Storages: Two acid storage tanks with a total capacity of 868 tons acid P_2O_5 ; one acid storage tank with a capacity of 4,719 gal of H_2SO_4 ; and one defoamer tank with a capacity of 14,305 gal.

Air Emissions: The Solvent-Extraction Pilot Plant has no air emissions and no permits; therefore, no allowable or actual conditions exist.

Water Discharges: Treated effluent from the Solvent-Extraction Pilot Plant after lime neutralization and settling in the 2-stage water treatment system is discharged and flows to Swift Creek--NPDES Sampling Point 001. The water balance is not included since this is an unscheduled intermittent operation.

A1.3.4 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF NEW PROCESS UNITS -SRCC
THE SUWANNEE RIVER CHEMICAL COMPLEX

A1.3.4.1 Phosphoric Acid Clarification

Type of Plant: Occidental proprietary process is used for removal of impurities from wet process phosphoric acid.

Capacity: Nominal capacity of 1600 short tons per day P_2O_5 .

Raw Materials: Wet process phosphoric acid.

Storages: Incorporated into clarification plant design.

Air Emissions: The Phosphoric Acid Clarification Plant has Florida construction permits AC24-2698 and AC-2699 currently in force. The allowable air emissions in the state of Florida are as follows:
Fluorides--Best available control technology (BACT), 0.05 lb/F/ton
 P_2O_5 input = 2.84 lb/hr and particulate at 7.72 lb/hr.

Water Discharges: Only nonprocess water is discharged. Process water is recirculated from No. 2 Gypsum Stack and Cooling Ponds, except when treatment of excess water is required. Nonprocess water is from vacuum pump seals, cooling for air compressors, oil coolers, air conditioners; and rainfall run-off is discharged to the freshwater ditch. Table A1.3-16 summarizes water uses and discharges.

A1.3.4.2 54 Percent P_2O_5 Evaporation

Type of Plant: Forced circulation type steam heated wet process phosphoric acid evaporators.

Capacity: Nominal capacity is 1450 short tons per day P_2O_5 .

Raw Materials: Wet process phosphoric acid.

Storages: One storage tank with a capacity of 500,000 gallons acid.

Air Emissions: No air emissions. Total condenser system used and control equipment not required.

Water Discharges: Only nonprocess water is regularly discharged. Process water is recirculated from No. 2 Gypsum Stack and Cooling Pond, except when treatment of excess water is required. Nonprocess water from vacuum pump seals is discharged to the freshwater ditch. Table A1.3-17 summarizes water uses and discharges.

A1.3.4.3 Superphosphoric Acid Plants A&B

Type of Plant: Forced circulation type steam heated superphosphoric acid evaporators. Product storage, and tank car cleaning station.

Capacity: Nominal capacity of 1450 short tons per day P_2O_5 .

Raw Materials: Wet process phosphoric acid.

Storages: Two tanks with a total storage capacity of 12,000 metric tons of acid.

Air Emissions: The Superphosphoric Acid Plants A&B have Florida Permits AC 24-2700 and AC 24-2701 which were issued 7-6-77 and expire 9-30-79. The allowable EPA guideline is 0.01 lb F/equivalent ton P_2O_5 feed and the expected performance is less than 0.01 lb F/equivalent ton P_2O_5 feed.

Water Discharges: Only nonprocess water is regularly discharged. Process water is recirculated from the No. 2 Gypsum Stack and Cooling Pond, except when treatment of excess water is required. Nonprocess water from the vacuum pump seal water is discharged to the freshwater ditch. Tables A1.3-18 and 19 summarize water uses and discharges.

A1.3.5 DESCRIPTION AND ENVIRONMENTAL ASPECTS OF AUXILIARY SUPPORT
FACILITIES FOR THE SUWANNEE RIVER CHEMICAL COMPLEX

A1.3.5.1 No. 1 Gypsum Stack and Cooling Ponds - Existing

Function: To store by-product waste gypsum and provide cooling for process water recirculated to the process units.

Size: A 329.5-acre site composed of 166 acres in Gypsum Pond Area and 163.5 acres in Surge Pond and Cooling Pond area. Total area for rainfall is 329.5 acres and total wet area for solar evaporation is 168.9 acres determined from an aerial photograph.

Capacity: Handles phosphoric acid Plant A, GTSP plant, DAP Plant No. 1, SPA Plants No. 1 and No. 2, Polyphos Plant, GTSP Storage and Shipping Building No. 1, and GTSP Storage Building No. 2.

Water Recirculation: This can vary from 24,000 gallons per minute (GPM) to 35,000 GPM, depending on the demand.

Water Discharge: No process water was discharged to the Liming Station in 1976 or 1977. In early 1978 process water was treated at a rate equivalent to 1,000 GPM for one month to increase surge volume. This was required, in part, because of displacement of process water with gypsum in the No. 2 Gypsum Pond associated with the 1975 SRCC expansion.

Water Balance: Detailed process water requirement calculations are based on planned operation and shows an average deficit water balance of 102 GPM average for 310 days per year operating time.

Process Water Treatment: The emergency treatment facility has a Florida permit I024-2118 which was issued 6-12-77 and expires 10-24-79. The 350-acre foot surge pond addition to gypsum storage water cooling area serving Area No. 1 circulation water system has a Florida permit IC24-2109 currently in force. The 65-acre gypsum removal stacking Area No. 1 expansion has a Florida permit IC24-2076 currently in force. The EPA discharge 001 has an EPA permit FL 0000655, issued 9-24-74 and currently in force.

At the Process Water Treatment Facility, process water flows by ditch to the No. 1 treatment area where it is treated with limestone to pH 3 and then flows into the No. 1 settling area of 19.3 acres which has a retention time of 200 hours. The partially treated water then flows to the No. 2 treatment area where the pH is adjusted to 8.0-9.0 and then flows into the No. 2 settling area of 13.7 acres which has a retention time of 700 hours. The water is discharged and flows to Swift Creek NPDES Sampling Point 001. For a summary of the allowable effluent limitations on the existing permits, see Table A1.3-20.

The process water treatment system was constructed in 1966, and treatment was conducted for a total of 10 weeks between 1966 and 1972. Modifications were made to the system in 1972, and treatment has not been required again until March 1978. The current design capacity of the system is 3000 GPM.

The system is comprised of two stages of chemical addition with intermediate and final clarification in settling ponds. In the first

treatment stage, pulverized calcium carbonate is added to neutralize the majority of the acidity and to precipitate the bulk of the fluoride. Calcium carbonate is delivered by truck, unloaded into a 100 ton storage silo, and fed into a 21,000 gallon reaction tank at a maximum rate of 695 pounds per minute. Reacted waste flows by gravity to a 15-acre settling and sludge storage pond.

Pebble quicklime is delivered by truck and unloaded into a 125-ton storage silo. The lime is slaked, slurried, and added in a second-stage 21,000 gallon reaction tank at a maximum rate of 86 pounds per minute of calcium hydroxide. Phosphorus and remaining fluoride are precipitated and the pH is adjusted to 7.0-9.0. Second-stage reacted waste flows by gravity to a 10-acre settling and sludge storage pond.

Supernatant from this pond, which is also reused for lime slaking and slurry water, is monitored to meet permit requirements and flows through a final storage and polishing pond prior to discharge.

Extensive process control and fail-safe alarms are practiced in both stages with automatic pH monitoring, indicating, recording, chemical dosage controlling, and alarm functions; flow metering and control; and automatic operation of chemical feed and make-up systems.

A.1.3.5.2 No. 2 Gypsum Stack and Cooling Pond--Existing

Function: To store by-product waste gypsum and provide cooling for process water (pond water) recirculated to the process units.

Size: A total of 461.7 acres which represents 261.7 acres in Gypsum Pond Area and 200 acres in Cooling Pond and Surge Pond Area. Total

area for rainfall is 461.7 acres and total wet area for solar evaporation is 243.5 acres as determined from an aerial photograph.

Capacity: Handles phosphoric acid Plants B&C, DAP Plant No. 2, and Phase I of SPA project.

Water Recirculation: Can vary from 56,000 to 88,000 GPM depending on demand.

Water Discharge: Discharge will be to process water treatment facility described in No. 1 Gypsum Stack and Cooling Ponds (permit IO 24-2118). There was no discharge in 1976 or 1977. Some process water was treated in early 1978.

Water Balance: Detail process water requirement calculations based on planned operation shows a deficit water balance of 383 GPM for 310 days per year operating time. The No. 2 Gypsum Stack and Cooling Pond has a Florida permit IO 24-2111 which was issued 6-10-77 and is currently in force. The process water treatment facility is the same system described in No. 1 Gypsum Stack and Cooling Pond. For a discussion on the allowable effluent limitations on existing permits, see No. 1 Gypsum Stack and Cooling Pond.

Nonprocess Water Discharge: Note: No additional water wells will be added.

Water Balance: The chemical plant well capacity is 15,000 GPM (3 wells at 5,000 GPM each). The average well water consumption will range

from 6,704 GPM to 8,341 GPM, 310 days per year, depending upon operations. The resulting nonprocess water is discharged to the freshwater ditch and will vary from an average of 4,160 GPM to 5,773 GPM, 310 days per year. The difference between well water use and nonprocess water discharge is due to evaporation in the cooling towers, chemical water consumption, steam, stack water, and water entering the process water systems. See Table A1.3-21 for water treatment results.

A1.3.5.3 Nonprocess Water Treatment

A separate system is used for the treatment of nonprocess water. Automatic treatment is provided when the pH falls below a preset level of 5.5 pH. A beacon alarm light is activated when a low pH is detected and remains on until manual acknowledgement of upset conditions is made. The low pH alarm signal starts a lime feed slurry addition sequence and an agitator which is suspended in the fresh water ditch. Hydrated lime from a storage bin is slurried with the water and added to the nonprocess water. When the pH returns to normal, the lime feed system continues to operate for up to 3 minutes and then stops automatically. The agitator continues to operate for 10 minutes. Limed water flows to a retention and surge pond of 29.3 acres with a retention time of 23 days for clarification. Clear effluent then discharges south to intercept Swift Creek.

The nonprocess treatment system, completed in 1976, has operated very infrequently, and contamination of nonprocess water has reportedly occurred approximately 12 days per year in the past 10 years.

A1.3.5.4 Domestic Water Treatment Plants--Existing

Note: No additional treatment plants will be added.

Function: Plant No. 1 serves office, lab, shops, phosphoric acid Plant A, GTSP Plant, DAP Plant 1, DAP Screening and Shipping, TSP Screening and Shipping, Sulfuric Acid Plants A&B, Polyphos Plant, and Ball Mills. Plant No. 2 serves phosphoric acid plants B&C, Sulfuric Acid Plants C&D, and DAP Plant 2, and will serve Phase I expansion.

Size: Plant No. 1 has a Marolf Sewage Treatment Plant, 20,000 gal. design--29.1 ft³ chlorine contact chamber. Plant No. 2 has one Marolf Sewage Treatment Plant, 5,000 gal. design; one Davco Sewage Treatment Plant, 5,000 gal. design--5,000 gal. aeration and 157 ft³ settling chamber and 29.1 ft³ chlorine contact chamber.

Capacity: Plant No. 1 has a 25,000 GPD capacity--population served is 150. Plant No. 2 has a 10,000 GPD capacity (two 5,000 GPD plants)--population served is 150.

Water Balance: Water discharges to the Suwannee River Mine Water System. Water uses and discharge is summarized in Table A1.3-22.

Water Treatment: Plant No. 1 has extended aeration process followed by chlorination; Plant No. 2 has extended aeration process followed by chlorination. The allowable effluent Florida limitations are 90 percent treatment or better. The actual effluent is as follows:

<u>Plant No. 1</u>	<u>Plant No. 2</u>
Feb. 1976 - Weekly tests	August 1975 tests
D.O.: 1.0-1.2 ppm	2.0-4.0 ppm
pH: 7.0.-7.2	6.8-7.4
Chlorine, resid.: 0.5-1.5	2.1-3.5
BOD: 12 ppm - 95 percent removal	4 to 8 - 97-98 percent
TSS: 16 ppm - 92 percent removal	26 to 235 ppm- 88-97 percent removal

Plant No. 1 has a Florida permit D024-2720, and Plant No. 2 D0-2540, both currently in force.

A1.3.5.5 Fresh Water Supply -Existing

The source of fresh water is from deep wells. There are no permits. For a description of the wells (number, size, capacity, depth, etc.), see Table A1.3-23. For a well analyses, see Table A1.3-24.

A1.3.5.6 Process Chemicals

For a description of the process chemicals, see Table A1.3-25.

A1.3.5.6.1 Defoamer

The total defoamer use is budgeted at 4,187 metric tons per year (MTPY) and is used in Phosphoric Acid Plants A, B, C, DAP Plant No. 1, Clarification, 54 percent P₂O₅ Evaporation, and the SPA Plants for foam prevention. A water-soluble defoamer is used and ends up in the SPA acid, granulation products, and the process water circuit. No discharge occurs to the nonprocess water system.

A1.3.5.6.2 Inorganic Chemicals

Total inorganic chemicals use are budgeted at 16,406 metric tons per year and leave the plant site in the granular fertilizer products. No discharge occurs to the nonprocess water system.

A1.3.5.6.3 Limestone and Lime

Limestone is budgeted at 8,568 metric tons per year and will leave the plant site in the granular fertilizer products. Lime is budgeted at 764 MTPY and will be used to treat nonprocess water when it becomes contaminated.

A1.3.5.7 Electric Power

Electric power will be supplied by Florida Power Corporation. There will be no on-site generation.

Table A1.3-1 Water Summary (Based on 310 DPY Operating Time) -
 MGD Suwannee River Chemical Complex Overall
 Balance on Complete Complex

	MGD	
	In	Out
Well Water	12.00	
Rainfall	3.20	
Vent Air (including combustion water)	0.15	
Water in Raw Materials	0.26	
Mine Water	0.46	
Natural Evaporation		1.95
Process Evaporation		1.75
Deposited Water with Gypsum		0.91
Chemically Combined Water		0.46
Chemically Combined Water in H_2SO_4		0.27
Scrubber Stacks		0.31
Cooling Tower Evaporation		2.34
Water in Products		0.01
Nonprocess Water*		8.31
Sanitary & Regeneration Water to Mine Water		0.20
Contaminated Water to No. 1 Gypsum Stack & Ponds		0.26
Deficit: Occidental Ponds - 0.15	0.70	
Deficit: CTC Ponds - 0.55		
TOTAL OVERALL BALANCE ON COMPLETE COMPLEX	16.77	16.77

* To Freshwater Ditch With Rainfall Run-off; see Individual Process Units for Nonprocess Water Sources Other Than Rainfall Run-Off.

Table A1.3-2 Water Summary (Based on 310 DPY Operating Time) -
GPM-Suwannee River Chemical Complex Overall
Balance on Complete Complex

	GPM	
	In	Out
Well Water	8,341	
Rainfall	2,222	
Vent Air (including combustion water)	103	
Water in Raw Materials	182	
Mine Water	320	
Natural Evaporation		1,358
Process Evaporation		1,214
Deposited Water with Gypsum		633
Chemically Combined Water		321
Chemically Combined Water in H_2SO_4		185
Scrubber Stacks		213
Cooling Tower Evaporation		1,622
Water in Products		7
Nonprocess Water*		5,773
Sanitary & Regeneration Water to Mine Water		141
Contaminated Water to No. 1 Gypsum Stack & Ponds		186
Deficit: Occidental Ponds - 0.15		
Deficit: CTC Ponds - 0.55	485	
TOTAL OVERALL BALANCE ON COMPLETE COMPLEX	11,653	11,653

* To Freshwater Ditch with Rainfall Run-off; see Individual Process Units for Nonprocess Water Sources Other Than Rainfall Run-off.

A1.3-3

Water Summary (Adjusted to 310 DPY Operation to
Conform with Phosphate Units) - Suwannee River
Chemical Complex - Sulfuric Acid Plants A & B

	GPM	
	In	Out
Fresh Water	1,746	
Steam		328 ⁽¹⁾
Softener & Regeneration		28 ⁽²⁾
Cooling Tower Evaporation & Drift		620
Nonprocess Water ⁽³⁾		685
Water in H ₂ SO ₄ - Free		26
Water in H ₂ SO ₄ - Chemical		66
Vent Air	7	
Total Sulfuric Acid Plants A & B	1,753	1,753

(1) Net export steam

(2) To mine water circuit

(3) Cooling tower and boiler blowdown, cooling water, sulfur melting condensate; excludes rainfall run-off.

Table A1.3-4 Water Summary (Adjusted to 310 DPY Operation to Conform with Phosphate Units) - Suwannee River Chemical Complex - Sulfuric Acid Plants C & D

	GPM	
	In	Out
Fresh Water	2,194	
Steam		604 ⁽¹⁾
Demineralizer Regeneration		55 ⁽²⁾
Condensate Return ⁽³⁾	619	
Cooling Tower Evaporation & Drift		997
Nonprocess Water ⁽⁴⁾		1,010
Water in H ₂ SO ₄ - Free		40
Water in H ₂ SO ₄ - Chemical		119
Vent Air	12	
Total Sulfuric Acid Plants C & D	2,825	2,825

(1) Net export steam

(2) To mine water circuit

(3) Returned from phosphoric acid evaporators

(4) Cooling tower and boiler blowdown, cooling water, sulfur melting condensate; excludes rainfall run-off

Table A1.3-5 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Phosphate Rock
 Grinding

	In	GPM Out
PHOSPHATE ROCK GRINDING		
Fresh Water	150	
Nonprocess Water ⁽¹⁾		150
TOTAL ROCK GRINDING	150	150

(1) To Fresh Water Ditch; Bearing Cooling Water; Excludes Rainfall
 Runoff

Table A1.3-6 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Phosphate Rock
 Transport No. 2

	In	GPM Out
PHOSPHATE ROCK TRANSPORT NO. 2:		
Wet Phosphate Rock	151	141
Fresh Water	24	
Drainage ⁽¹⁾		34
TOTAL PHOSPHATE ROCK TRANSPORT NO. 2	175	175

(1) To SRM Mine Water Circuit; Excludes Rainfall Run-off

A1.3-7

Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Phosphoric Acid
 Plant A (Dorr-Oliver)

	GPM	
	In	Out
ATTACK & FILTRATION:		
Cold Pond Water	7,777	
Phosphate Rock	6	
93 Percent H ₂ SO ₄ (Free Water)	26	
Fresh Water	1,624	
28 Percent P ₂ O ₅ Acid (Free Water)		255
Warm Pond Water to Pond		7,474
Condensate (Filter Wash)	13	
Chemically Combined H ₂ O ⁽¹⁾		122
Nonprocess Water ⁽²⁾		1,590
Vent Air	3	
Stack		8
TOTAL REACTION & FILTRATION	9,449	9,449
EVAPORATION:		
Steam	163	
Cold Pond Water (4 Evaporators)	4,700	
28 Percent P ₂ O ₅ Acid	239	
42 Percent P ₂ O ₅ Acid		110
Warm Pond Water		4,847
Nonprocess Water ⁽²⁾		202
Condensate (Filter & Evaporator Wash)		13
Fresh Water	70	
	5,172	5,172

(1) Gypsum cake hydration water

(2) Vacuum pump seals; filter vacuum scrubbers, filter skirt sprays
 (noncontact) & condensate; to fresh water ditch; Excludes
 rainfall run-off

Table A1.3-8 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Phosphoric Acid
 Plant B (Prayon)

	GPM	
	In	Out
ATTACK & FILTRATION:		
Steam	13	
Cold Pond H ₂ O	12,013	
Phosphate Rock	104	
93 Percent H ₂ SO ₄ (Free Water)	37	
Fresh Water	895	
28 Percent P ₂ O ₅ Acid (Free Water)		361
Warm Pond Water to Pond		11,697
Condensate (Filter Wash)	28	
Chemically Combined H ₂ O ⁽¹⁾		173
Nonprocess Water ⁽²⁾		850
Vent Air	5	
Stack		14
TOTAL ATTACK & FILTRATION	13,095	13,095
EVAPORATION:		
Steam	261	
Cold Pond Water	7,601	
28 Percent P ₂ O ₅ Acid	381	
42 Percent P ₂ O ₅ Acid		174
Warm Pond Water		7,834
Nonprocess Water ⁽²⁾		25
Condensate (Filter & Evaporator Wash)		28
Fresh Water	25	
TOTAL EVAPORATION	8,268	8,268

(1) Gypsum cake hydration water

(2) Vacuum pump seals, cooling water, filter skirt sprays
 (noncontact water) to freshwater ditch; excludes rainfall run-off

Table A1.3-9 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Phosphoric Acid
 Plant C

	GPM	
	In	Out
ATTACK & FILTRATION:		
Steam	13	
Cold Pond H ₂ O	4,680	
Phosphate Rock	37	
98 Percent H ₂ SO ₄ (Free Water)	3	
Fresh Water	380	
40 Percent P ₂ O ₅ Acid (Free Water)		55
Warm Pond Water to Pond		4,705
Condensate (Filter Wash)	12	
Chemically Combined H ₂ O ⁽¹⁾		16
Nonprocess Water ⁽²⁾		340
Vent Air	5	
Stack		14
TOTAL REACTION & FILTRATION	5,130	5,130
EVAPORATION:		
Steam	131	
Cold Pond Water (4 Evaporators)	4,103	
40 Percent P ₂ O ₅ Acid	237	
48 Percent P ₂ O ₅ Acid		132
Warm Pond Water		4,226
Nonprocess Water ⁽²⁾		25
Condensate to H ₂ SO ₄ Plant		101
Condensate (Filter Wash)		12
Fresh Water	25	
TOTAL EVAPORATION	4,496	4,496

(1) Gypsum cake hydration water

(2) Vacuum pump seals: to freshwater ditch; excludes rainfall
 run-off

Table A1.3-10 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Granular
 Triplesuperphosphate (GTSP) Plant

	In	GPM Out
GTSP PLANT:		
Cold Pond Water	1,800	
Warm Pond Water to Pond		1,867
Vent Air (Including Combustion Water)	20	
40 Percent P ₂ O ₅ Acid	42	
Product GTSP		3
Stack		29
Phosphate Rock	2	
Steam	20	
Nonprocess Water ⁽¹⁾		30
Fresh Water	45	
TOTAL GTSP PLANT	1,929	1,929

(1) To freshwater ditch; excludes rainfall run-off

Table A1.3-11 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Diammonium
 Phosphate (DAP) Plant No. 1

	In	GPM	Out
DAP PLANT:			
Cold Pond Water	1,800		
Warm Pond Water to Pond			1,829
Vent Air (Including Combustion Water)	12		
Raw Materials	27		
Product			3
Stack			26
Steam	4		
Nonprocess Water ⁽¹⁾			30
Fresh Water	45		
TOTAL DAP PLANT NO. 1	1,888		1,888

(1) To Freshwater Ditch; Excludes Rainfall Run-Off

Table A1.3-12 Water Summary (Based on 310 nPY Operating Time)
 -Suwannee River Chemical Complex-Diammonium
 Phosphate (DAP) Plant No. 2

	In	GPM Out
DAP PLANT:		
Cold Pond Water	3,800	
Warm Pond Water to Pond		3,829
Vent Air (Including Combustion Water)	15	
40% P ₂ O ₅ Acid	41	
Product DAP		1
Stack		41
Nonprocess Water ⁽¹⁾		100
Fresh Water	115	
TOTAL DAP PLANT NO. 2	3,971	3,971

(1) To Freshwater Ditch; Excludes Rainfall Run-Off

Table A1.3-13 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Ammonia Storage Area

	In	GPM Out
AMMONIA STORAGE AREA:		
Fresh Water	80	
Nonprocess Water		75
Evaporation		5
TOTAL AMMONIA STORAGE AREA	80	80

Note: Excludes Rainfall Run-off

Table A1.3-14 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Polyphos Plant

	In	GPM Out
POLYPHOS PLANT:		
Cold Pond Water	3,686	
Mine Water	320	
Vent Air (Including Combustion Water)	20	
Phosphoric Acid	3	
Raw Materials	5	
Fresh Water	162	
Warm Pond Water		3,827
Stack		68
Nonprocess Water (1)		115
Contaminated Water to No. 1 Gypsum Stack Ponds		186
TOTAL POLYPHOS PLANT	4,196	4,196

(1) To freshwater ditch; excludes rainfall run-off

Table A1.3-15 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-GTSP Storage &
 Shipping No. 1 & No. 2 & DAP Storage & Shipping

	In	GPM Out
GTSP & DAP STORAGE & SHIPPING:		
Fresh Water	10	
Cold Water Pond	2,500	2,510
TOTAL GRANULAR STORAGE & SHIPPING	2,510	2,510

Note: Excludes rainfall run-off

Table A1.3-16 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Clarification

	In	GPM Out
CLARIFICATION		
Steam	9	
Cold Pond H ₂ O	1,783	
Phosphoric Acid Feed	136	
Raw Materials	2	
Fresh Water	360	
Phosphoric Acid Product		128
Warm Pond Water to Pond		1,773
Nonprocess Water (1)		350
By-Products		30
Vent Air	4	
Stack		13
TOTAL CLARIFICATION:	2,294	2,294

(1) To freshwater ditch; vacuum pump seals; air compressor cooling;
 air conditioner, oil cooling; excludes rainfall run-off

Table A1.3-17 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex- 54 Percent P_2O_5
 Evaporation

	In	GPM Out
54 Percent P_2O_5 EVAPORATION:		
Steam	103	
Cold Pond Water	6,400	
Feed Acid	128	
54 Percent P_2O_5 Acid		67
Warm Pond Water		6,479
Nonprocess Water (1)		160
Condensate to H_2SO_4		99
Fresh Water	174	
TOTAL 54 Percent P_2O_5 EVAPORATION	6,805	6,805

(1) To freshwater ditch; vacuum pump seal water; excludes rainfall run-off

Table A1.3-18 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-Superphosphoric
 Acid Plants A & B

	In	GPM	Out
SUPERPHOSPHORIC ACID PLANTS A & B:			
Steam		212	
Cold Pond Water	14,256		
54 Percent P ₂ O ₅	67		
70 Percent P ₂ O ₅ Acid			(38)(1)
Warm Pond Water		14,363	
Nonprocess Water (2)		160	
Condensate to H ₂ SO ₄		212	
Fresh Water	162		
TOTAL SUPERPHOSPHORIC ACID PLANTS A & B	14,697		14,697

(1) () denotes negative; chemical water removed

(2) To freshwater ditch; vacuum pump seal water; excludes rainfall run-off

Table A1.3-19 Water Summary (Based on 310 DPY Operating Time)
 -Suwannee River Chemical Complex-SPA Storage
 & Shipping

	In	GPM	Out
SPA STORAGE & SHIPPING:			
Steam	3		
Fresh Water	5		
Nonprocess Water (1)			3
Condensate to H ₂ SO ₄ Plant			3
Pond Water	3		5
TOTAL SPA STORAGE & SHIPPING	11		11

(1) To freshwater ditch; excludes rainfall run-off

Table A1.3-20

Allowable Effluent Limitations on Existing Permits

	<u>Existing NPDES Permit</u>		<u>Existing EPA Guidelines</u>		<u>Proposed EPA Permit⁽¹⁾</u>	
	Daily Av. MG/L	Daily Max. MG/L	Daily Av. MG/L	Daily Max. MG/L	Daily Av. MG/L	Daily Max. MG/L
TSS ⁽²⁾	25	50	50	150	50	150
Total Phosphorus (as P)	35	70	35	105	35	105
Fluoride	15	30	25	75	25	75
Ra-226	9.0 pCi/L		-	-	9 pCi/L	9 pCi/L
pH	8.0 - 9.5				5-9 @ 001-4	

(1) 4/1/78 - Locations shown on Figure 1.3-3.

(2) Waived if chemically treated and settled to meet other limitations

Table A1.3-21 Water Treatment Effluents

<u>Allowable Effluent Limitations on EPA Permits</u>					
	Existing Permit, MG/L	Existing EPA Guidelines, MG/L		Proposed EPA Permits, ⁽¹⁾ 4/1/78 - MG/L	
	Daily Max.	Daily Av.	Daily Max.	Daily Av.	Daily Max.
TSS	90	-	-	-	-
Total Phosphorus (as P)	10	35	105	35	105
Fluorides	10	25	75	25	75
pH	6.0-9.0			5-9 @ 001-4	

(1) Locations shown on Figure 1.3-3

<u>Actual Effluent*</u>				
<u>Effluent Composition⁽¹⁾ - Jan. 1976-Sept. 1977 - 21 Months</u>				
	Min.	Av.	Max.	Sample Frequency
TSS, MG/L	0	22.3	88	1/5
Total Phosphorus (as P), MG/L	0	2.7	12.7	1/5
Fluoride, MG/L	1.0	5.4	10.0	1/5
pH	4.6	5.8	6.9	1/5

* Sampled at discharge 001 which contains effluents from Suwannee River Mine and Swift Creek Mine

(1) Summary from EPA monthly NPDES Reports - Form No. 158-R0073

Table A1.3-22 Water Summary-(Based on 310 DPY Operating Time)
Suwannee River Chemical Complex-General Facilities

General Facilities	GPM	
	In	Out
Fresh Water	94	
Rainfall into Process Areas	7	
Sanitary Water to Mine Circuit		24
Rainfall to Ponds		7
Non-Process Water (1)		70
Total General Facilities	101	101

(1) To Freshwater Ditch; Plant Air Compressor Cooling, Air Conditioners, Oil Cooling; Excludes Rainfall Run-off

Table A1.3-23 Description of Wells-- Suwannee River Chemical Complex

Well		Capacity, GPM	Depth	Casing
No.	Name			
C-1	Chemical Plant No. 1	5,000	803'	34"/26"
C-2	Chemical Plant No. 2	5,000	700'	34"/26"
C-3	Chemical Plant No. 3	5,000	800'	34"
CD-1	Chemical Plant Potable No. 1	200	315'	6"
CD-2	Chemical Plant Potable No. 2	250	248'	8"

Table A1.3-24 Suwannee River Chemical Complex - Fresh Well Water Analyses

Certificate of Analysis*				
Laboratory Marks	Deep Well No. C-1	Deep Well No. C-2	Deep Well No. CD-1	Deep Well No. CD-2
pH	8.15	7.6	7.48	7.75
Color	40	15	5	15
Odor	None	Indefinite	None	None
Alkalinity	178 ppm	186 ppm	167 ppm	196 ppm
Total Hardness as CaCO_3	204 ppm	312 ppm	220 ppm	203 ppm
Total Solids	314 ppm	477 ppm	314 ppm	297 ppm
Total Volatile Solids	105 ppm	129 ppm	111 ppm	97 ppm
Fixed Solids	209 ppm	348 ppm	203 ppm	200 ppm
Nitrate Nitrogen ($\text{NO}_3\text{-N}$)	0.15 ppm	0.21 ppm	0.16 ppm	0.15 ppm
Sulfate (SO_4)	59 ppm	145 ppm	55 ppm	24 ppm
Hydrogen Sulfide	0.16 ppm	0.47 ppm	-	-
Chloride (Cl)	13 ppm	21 ppm	20 ppm	9.9 ppm
Fluoride (F)	0.42 ppm	0.42 ppm	0.38 ppm	0.54 ppm
Calcium (Ca)	76 ppm	99 ppm	56 ppm	53 ppm
Magnesium (Mg)	3.3 ppm	15 ppm	18 ppm	17 ppm
Iron (Fe)	0.20 ppm	0.94 ppm	0.19 ppm	0.24 ppm
Sodium (Na)	11 ppm	18 ppm	10 ppm	6.7 ppm
Potassium (K)	1.5 ppm	2.1 ppm	1.2 ppm	0.93 ppm
Non-Carbonated Hardness as CaCO_3	26 ppm	126 ppm	53 ppm	7.4 ppm
Silica (SiO_2)	30 ppm	36 ppm	34 ppm	57 ppm
Sodium Chloride (NaCl)	21 ppm	35 ppm	33 ppm	16 ppm

* Thornton Laboratories, Tampa, Florida, March 4, 1976

Table A1.3-25 Process Chemicals-Sulfuric Acid Plant Boiler and Cooling Tower Chemicals (at Rated Capacities)

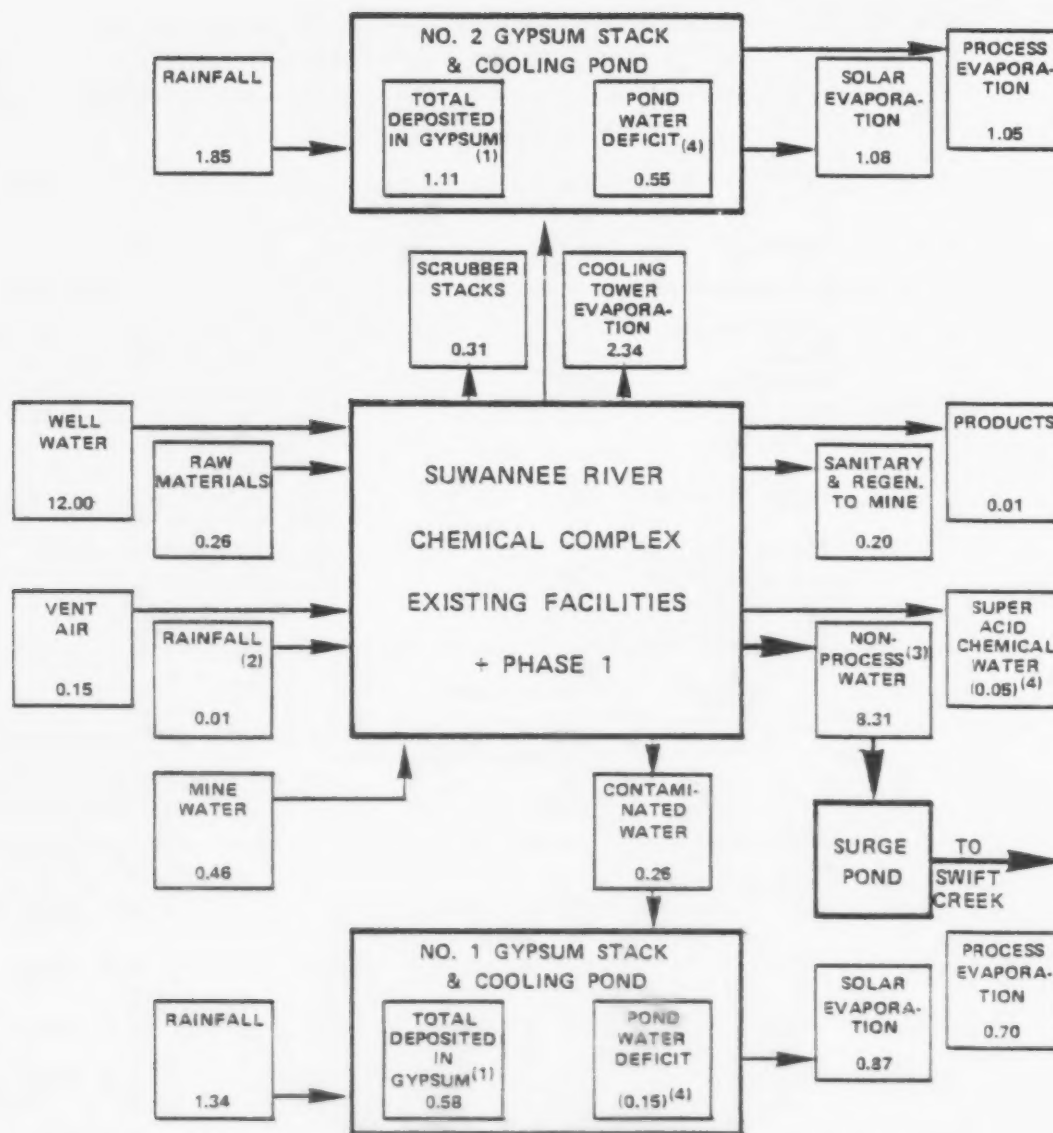
Water Treatment Chemicals ⁽¹⁾				
Unit	Material	Sulfuric Acid Plants		Description
		A&B lbs/day	C&D lbs/day	
Boiler	Liqui-Treat	252	180	Organic & Inorganic Chelant
"	NA-5	36	12	Neutralizing Amine
"	Corrogen	28	35	Catalyzed Sodium Sulfite
Cooling	Betz 55	93	-	Poly Phosphate Inhibitor
"	Betz 419	77	-	Phosphonate Based Dispersant
"	Betz 430 or 431	93	108	L.W. Polymer and Phosphonate Dispersant
"	Slimicide J-12	-	40 ⁽²⁾	Non-Oxidizing Biocide
"	Slimicide Other	20	-	Non-Oxidizing Biocide
"	Chloride	20	20	Chlorine

Effluent Loadings ⁽¹⁾				
Chemical	Sulfuric Acid Plants			Concentration Increase In Nonprocess Water ⁽³⁾
	A&B lbs/day	C&D lbs/day	Total lbs/day	
Sulfate & Sulfide as SO ₄	2337	2375	4712	68 MG/L
Chloride as Cl	330	134	464	6.7 MG/L
Calcium as CaCO ₃	870	1584	2454	35.4 MG/L
Magnesium as CaCO ₃	330	600	930	13.4 MG/L
Silica as SiO ₂	145	265	410	5.9 MG/L
Total Phosphate as PO ₄	23.2	41	64.2	0.92 MG/L
Total Copper as Cu	0.12	0.14	0.26	3.7 µGM/L
Total Iron as Fe	4.5	3.6	8.1	0.12 MG/L
Soluble Zinc as Zn	0.12	0.24	0.36	5.2 µGM/L

(1) Betz Laboratories, Inc. to Occidental Chemical, 12/23/77

(2) Reduced now to 15-20 lbs/day

(3) Based on Freshwater Ditch Flow of 8.31 MGD

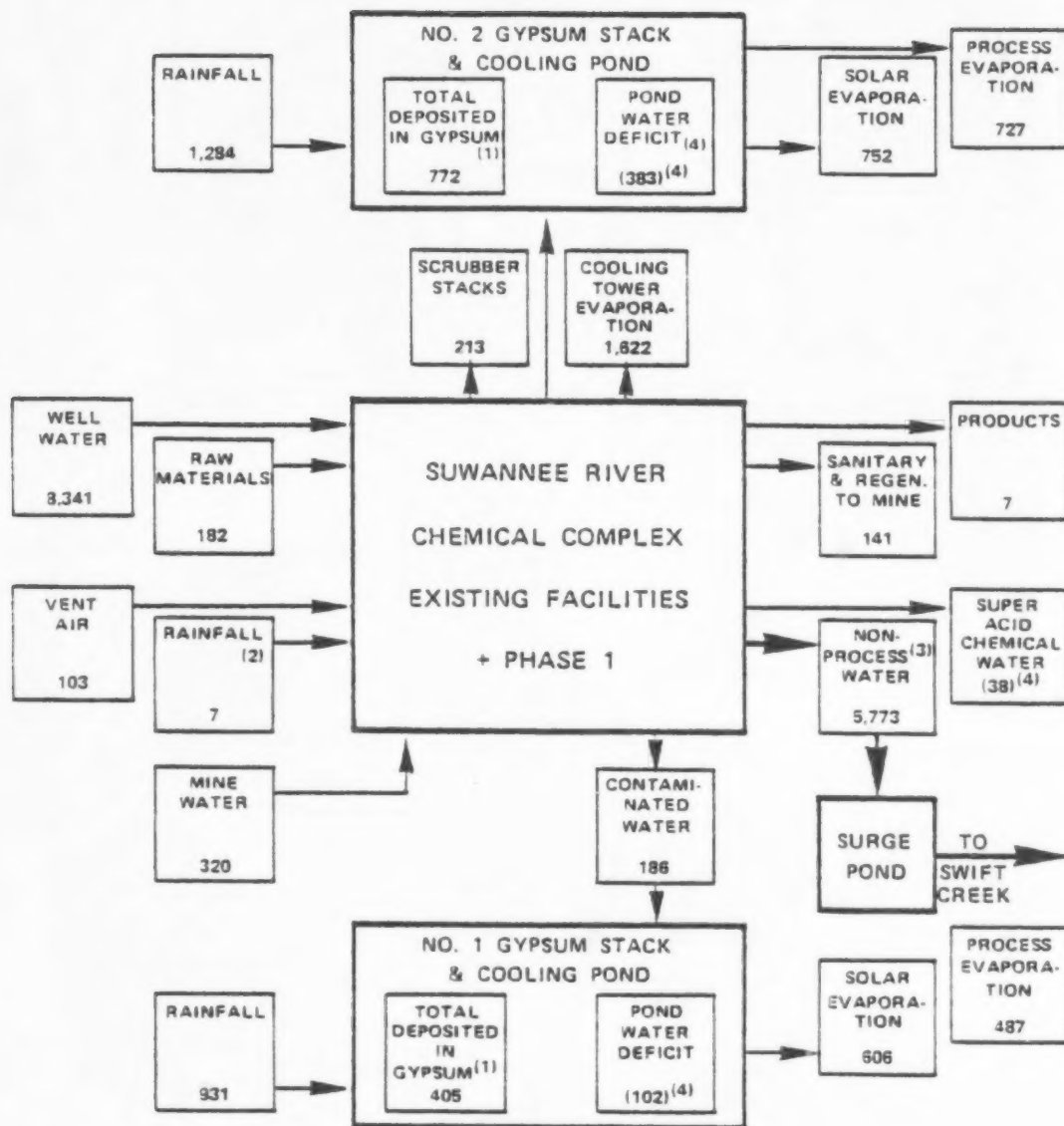


ALL VALUES IN AVERAGE MGD,⁽⁵⁾ 310 DPY OPERATING TIME

1. INCLUDES CHEMICALLY COMBINED AND FREE WATER IN GYPSUM PLUS CHEMICALLY COMBINED WATER IN SULFURIC ACID.
2. LIMITED TO RAINFALL INTO PROCESS AREAS DRAINING TO COOLING PONDS.
3. DISCHARGED TO NON-PROCESS WATER SURGE POND.
4. () DENOTES NEGATIVE VALUE.
5. MILLIONS OF GALLONS PER DAY.

WATER SUMMARY – MGD SUWANNEE RIVER CHEMICAL COMPLEX

FIGURE A1.3-1



ALL VALUES IN AVERAGE GPM, 310 DPY OPERATING TIME

1. INCLUDES CHEMICALLY COMBINED AND FREE WATER IN GYPSUM PLUS CHEMICALLY COMBINED WATER IN SULFURIC ACID.
2. LIMITED TO RAINFALL INTO PROCESS AREAS DRAINING TO COOLING PONDS.
3. DISCHARGED TO NON-PROCESS WATER SURGE POND.
4. () DENOTES NEGATIVE VALUE.

WATER SUMMARY-GPM SUWANNEE RIVER CHEMICAL COMPLEX

FIGURE A1.3-2

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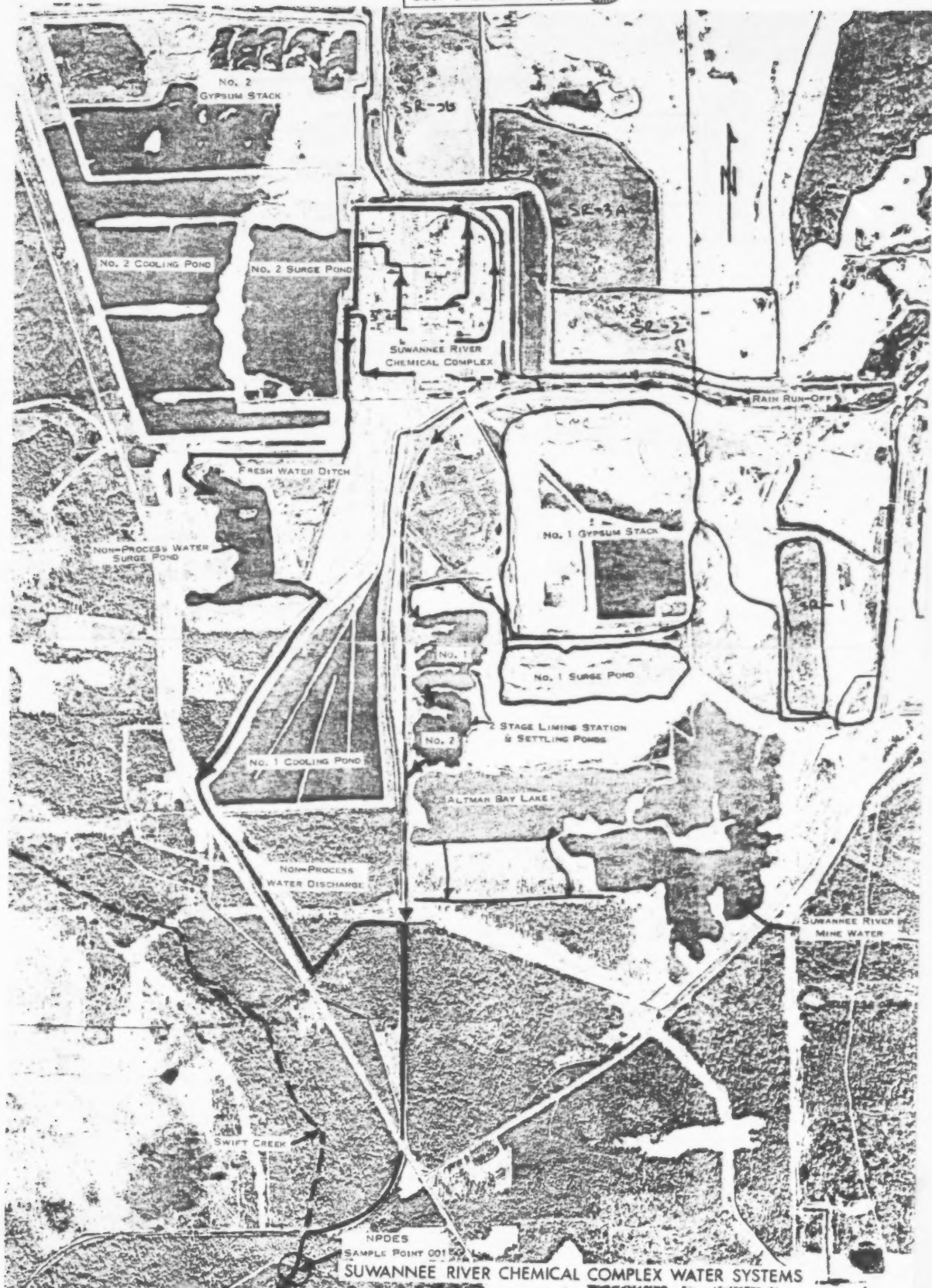


FIGURE A1.3-3

A1.3.6 REFERENCES

Davy-Powergass, Drawings and Equipment Specifications for Expansion, Engineered and Constructed in 1974 and 1975.

Davy-Powergass, Material Balance Flowsheets for Phae I Expansion, Now in Progress, Plant Areas 53 and 54

Door-Oliver, Drawings and Equipment Specifications, in GFP&A Files, for Initial Facilities, Engineered and Constructed in 1965 and 1966.

EPA, NPDES Monthly Reports, Form 158-R0073, January 1976 through First Quarter of 1978.

Florida, State of, Department of Environmental Regulation (FDER), Twenty-two FDER Air Permits are Referenced in Each Process Plant Area.

Florida, State of, Department of Environmental Regulation (FDER), Three FDER Dam Permits.

Florida, State of, Department of Environmental Regulation (FDER), Two FDER Domestic Water Treatment Plant Permits.

OXY/SPA Project Scope, Addendum.

Polyphos, Operating Manual, Septeber 15, 1970.

SECTION 2.0
ENVIRONMENT WITHOUT THE PROPOSED ACTION

2.1 METEOROLOGY AND CLIMATOLOGY

2.1.1 CLIMATOLOGICAL SUMMARY

The Occidental site is located in northern Florida approximately 14 miles (23 kilometers) south of the Georgia-Florida State line, and 71 miles (110 kilometers) west of Jacksonville, Florida (Figure 2.1-1). The site is near the northern boundary of the tradewinds and is characterized by relatively dry winters and rainy summers, a high annual percentage of sunshine, and high humidities. The terrain in the area of the proposed plant site is level and produces no significant effects on local climatology or meteorology.

Being south of the usual path of winter storms the area seldom experiences strong winds or severe cold weather. Winds in the area are moderate, blowing from the southwest during the late spring and summer, the northeast in the fall, and northwest during the winter and early spring.

The greatest rainfall is usually in the form of local thunder-showers and occurs primarily during the summer months. During this period measurable amounts of rain can be expected one day in two.

The annual relative humidity averages 76 percent, ranging from 70 in the early spring to 81 in the late summer. Daily relative

humidity ranges from the high 90 percentile in the early morning to the mid-50 percentile during the afternoon.

The annual mean temperature for the site is 68°F (20°C). June, July and August are the hottest months with an average temperature of 81°F (27°C). During December, January and February, the coldest months, the mean temperature averages 55°F (13°C). Temperatures fall below freezing 12 to 15 times per year but in most cases the temperature rises above freezing during the daytime hours.

The probability of severe weather occurring at the Occidental site is quite low. The chance of a hurricane-force wind in the area in a given year is less than one in 50. The mean annual frequency of a tornado occurring in a 1 degree square centered in Hamilton County is 0.65. The extreme wind expected to occur once in a hundred years is 110 miles an hour. No hailstorms of an intensity that caused significant damage have ever been reported in Hamilton County.

2.1.2 TEMPERATURE

The annual average temperature for the Occidental site, based on a 65 year record, is 68°F (20°C). This ranges from a monthly average of 81°F (27°C) in July and August to a monthly average

of 55°F (13°C) in January. The mean maximum monthly temperature is 91°F (33°C) during the months of June, July and August. The mean monthly minimum temperature is 45°F (7°C) during the months of December, January and February.

During the 65 year period 1913 to 1977 the extreme temperatures were 106°F (41°C) and 6°F (14°C). Freezing temperatures occur on the average of 12 times per year. The first winter freeze normally occurs in early December and the last freeze normally occurs in mid-February. The mean number of non-freeze days between these dates is 295.

In Table 2.1-1 a summary of temperature data from Lake City is presented. Lake City is located 23 miles (38 kilometers) southeast of the Occidental site. In Figure 2.1-2, temperature data from Lake City and two other nearby sites are graphically presented.

2.1.3 PRECIPITATION AND EVAPORATION

The rainfall in Hamilton County can be divided into two regimes; the wet summer months characterized by thunderstorm activity and the dry fall and winter months. Rainfall during the fall and winter is usually generated by the passage of frontal systems. On these occasions rainfall is widespread and of low intensity. During the months of June, July, August and September rainfall is usually in the form of thundershowers. These will occur on the average of one day in two and account for over 50 percent of the annual rainfall. Mean monthly rainfall ranges from 2 to 3 inches during the fall and winter months to 6 to 8 inches during the summer months (Figure 2.1-3).

The long-term average rainfall at the Occidental site is approximately 54 inches per year. The mean annual precipitation has varied from 33 inches to more than 75 inches.

Severe rainfall can occur any time throughout the year, but is usually associated with thunderstorm activity or the passage of tropical disturbances. Rainfall intensity data are presented in Figure 2.1-4.

The average annual open water evaporation in Hamilton County is approximately 46 inches per year (Visser and Hughes, 1969) and the evapotranspiration rate from soil and vegetation averages 40 inches per year (Fisk, 1977). The monthly evaporation data are presented in Figure 2.1-5.

2.1.4 VERTICAL MIXING AND VENTILATION

The vertical mixing depth is the thickness of the atmospheric layer through which turbulent mixing occurs. It is limited at the base (usually) by the earth's surface and at the top by a layer of stable air. In air pollution studies the vertical mixing depth defines the vertical dimension of the volume of air that pollutants are dispersed into. The transverse dimension is defined by the fluctuation in wind direction and by horizontal dispersion. The longitudinal dimension of the air volume is defined by wind speed and time. The combination of these factors defines atmospheric ventilation. Valdosta, Georgia surface observations and Waycross, Georgia upper air data for the period 1972-1976 were used as the source of these data.

The vertical mixing depth usually does not effect the maximum ground-level pollutant concentration until the mixing depth becomes less than twice the physical stack height. In the case of the proposed Occidental sources this limiting mixing depth would be 120 meters (two times the 200-foot stack heights). An analysis of Waycross, Georgia mixing height data for the period 1972 to 1976 showed that this limiting mixing height can be expected to occur on 13.9 percent of the days during a year or approximately 4.5 percent of the hours during a year. During the five year period reviewed the period of time during which the mixing height was less than 120 meters never exceeded a 12 hour period.

The number of days on which the mixing height can be expected to be less than 120 meters is greatest during the period October through April. During this period the mixing depth can be expected to be less than 120 meters on approximately six days per month, or approximately seven percent of the total hours during a month. During the period May through September the mixing depth can be expected to be less than 120 meters on approximately one day per month, or approximately two percent of the hours during a month.

The annual morning mixing depth averages 500 meters; ranging from 400 in fall and winter to 600 meters in the spring and summer.

The annual afternoon mixing depth averages 1,450 meters; ranging from 1,100 meters during the winter to 1,700 meters in the summer (Holzworth, 1972). During a one year period the number of forecast-days of high meteorological potential for air pollution at the Occidental site is one (Holzworth, 1972).

2.1.5 WIND AND ATMOSPHERIC STABILITY

Wind and atmospheric stability are two of the three major factors affecting atmospheric ventilation, the rate of air pollutant dispersion. Wind direction and the horizontal dispersion rate (a function of stability) define the transverse dimension of the volume of air into which a pollutant is dispersed. Wind speed and time define the longitudinal dimension.

A meteorological station exists at the Occidental site for recording wind speed and direction, ambient temperature and rainfall. The record of wind data from the site has been quite complete since March, 1976. The data are inadequate for air quality modeling; however, since EPA guidelines (EPA, 1977) now suggest a five-year record of meteorological data for establishing baseline air quality and projecting the impact of a proposed facility.

The Occidental wind data were used, however, to evaluate the applicability of available meteorological data from representative sites. The sites investigated were Jacksonville, Florida and Valdosta, Georgia.

Jacksonville is located 110 kilometers east of the Occidental site and 21 kilometers from the Atlantic coast. Valdosta is located 59 kilometers northwest of Occidental and is inland similar to the Occidental site.

Monthly wind direction distributions for several months in 1976 from Occidental, Jacksonville, and Valdosta were compared as an initial step in comparing the three data sets. The general distributions for the three sites were quite similar. The distributions from Jacksonville exhibited some anomolous "spikes", however, representing higher than expected occurrences of specific wind directions.

Because of the uniform wind direction distribution and the overall similarity with the Occidental wind direction distribution the Valdosta meteorological data were selected for air quality modeling and to describe site climatology. Valdosta is also an inland site, similar to Occidental, a fact which reinforces the selection of this site for meteorological data.

For air quality modeling and to describe site climatology data representing the five year period 1972-76 were obtained from the National Oceanographic and Atmospheric Administration, National Climatic Center in Ashville, North Carolina. The data included surface observations from Valdosta and upper air data from Waycross, Georgia. These data were analyzed with the CRSTER meteorological data pre-processor program to randomize wind directions and to derive atmospheric stability data.

The atmospheric stability categories are defined from measurements of insolation and wind speed. The atmospheric stability categories were defined by the system of Turner (1961). The area has an occurrence of unstable conditions 25.1 percent of the time, neutral conditions 33.1 percent; and stable conditions 41.8 percent.

Winds are normally from the northeast in the fall, south to northwest in the winter, and the southwest in the spring. During the summer the winds are predominantly from the northeast and southwest. Annually the wind direction distribution is quite uniform with only a slight northeast-southwest predominance (Figure 2.1-6).

The annual average wind speed is 3.1 meters per second (7 mph); that executed 10 percent of the time is 5.0 meters per second (11 mpg). The maximum recorded wind speed in the area occurring with the passing of hurricane Donna through Jacksonville in 1964, was 36.6 meters per second (82 mph).

Joint wind speed/wind direction/stability frequencies are presented in Table 2.1-2 for the five year period 1972-1976 for Valdosta, Georgia.

2.1.6 HUMIDITY AND FOG

Humidity is of importance because of the fogging potential created by cooling towers. With large cooling towers such as those associated with large electric, power generating stations the potential for artificially

created fog occurs when there is a deficit between the actual and saturation moisture content of the air of less than 0.1 grams per cubic meter. This deficit is related to air temperature, dew point temperature and relative humidity in Table 2.1-3. It should be noted that the cooling towers proposed for the Occidental site are quite small and will be expected to increase the fogging potential only in a very limited area around the plant site.

To determine the number of hours during which artificially created fog might exist, meteorological data from Valdosta for the years 1973 and 1974 were reviewed.

It was found that fog or ground fog was reported over 200 days per year. On these days fog or ground fog lasted an average of five hours; ranging from approximately nine hours during the months of October through January to approximately two hours during the months of June and July. In most all cases, the fog or ground fog developed after midnight and was dissipated by 0900 to 1000 hours. The total number of hours of fog and ground fog was approximately 1,000 hours per year.

Lake City data for the period 1962 to 1976 were also reviewed for occurrence of fog. The criteria of a ceiling less than 300 feet

and a visibility of less than one mile were used as an indicator of an occurrence of fog (not including ground fog). Using these criteria, fog existed approximately 300 hours on an annual basis. Approximately 60 percent of these hours occurred during the time period 0300 to 0800 hours.

During the 1973-1974 period the potential for artificially induced fog, as defined in Table 2.1-3, existed 480 hours or approximately half the total number of hours with fog and ground fog. In general, these hours preceded or were interdispersed with periods of fog. In very few cases did the hours of potential fog follow periods of fog.

It can be expected, therefore, that the number of hours of fog may be increased by 50 percent. Because of the size of the cooling towers, however, the artificially created fog will be expected to occur only in the vicinity of the plant site. In general, the artificially created fog will develop late at night and in very few cases will it cause naturally occurring periods of fog to extend beyond 0900 to 1000 hours.

2.1.7 SEVERE WEATHER

Since 1885 there have been 75 hurricanes reported in Florida; 42 since 1900. Of the 42 hurricanes since 1900, 10 have passed through or near Hamilton County. The storms usually approach from the south

to southwest and, because of the relatively long overland travel distance, are usually reduced to tropical storms (wind speeds less than 72 miles per hour) before reaching Hamilton County. The chance of a hurricane-force wind in Hamilton County in any given year is less than on in 50 (Dunn, 1969).

During the period 1916 to 1969, a total of 590 tornadoes have been reported in Florida. Approximately 66 of these were associated with the passage of tropical storms. According to statistics compiled by Thom (1963) the mean annual frequency of a tornado occurring in a one degree square (4145 square miles) centered at Hamilton County is 0.65. The probability of a tornado hitting any given spot in Hamilton County is 0.000442, or once in 2260 years.

The extreme wind speed (Thom, 1967) expected to occur once in 100 years in Hamilton County is 110 miles per hour; that expected in 50 years is 90 miles per hour; and that expected in 25 years is 80 miles per hour. Based on a gustiness factor of 1.3 (Huss, 1946), the extreme gusts expected in 100 years is 143 miles per hour.

Hailstorms (Flora, 1956) occur quite in frequently in Florida. During the period 1904 to 1943 the frequency of occurrence statewide was less than one per year. During the period 1925 to 1954, 37

hailstorms were reported in Florida. Approximately 60 percent of these occurred in April and May and most occurred between the hours of 1400 and 1800. Of the 37 hailstorms reported during the 1925 to 1954 period, no severe storms (damage greater than \$100,000) occurred in Hamilton County.

Thunderstorms occur quite frequently throughout Florida. A review of Lake City, Florida meteorological data covering the period 1952 to 1976 showed that thunderstorms can be expected on 68 days per year. Thunderstorms occur most frequently during the months of June, July and August when a thunderstorm can be expected approximately one day in two. During the months of November, December and January, less than one thunderstorm per month can be expected

Table 2.1-1 Summary of Long-Term Ambient Temperature Data - Lake City, Florida

Parameter ⁽¹⁾	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Absolute Maximum Temp.	85	89	96	95	101	106	102	103	101	96	90	85	106
Mean Maximum Temp.	67	70	76	81	87	91	91	91	88	81	73	67	80
Mean Monthly Temp (2)	55	57	62	69	75	80	81	81	78	70	61	56	69
Mean Minimum Temp.	44	46	51	51	63	69	71	71	69	60	50	45	58
Absolute Minimum Temp.	16	6	23	33	42	52	59	59	49	32	20	12	6
Mean no. days with temp. greater than 90°F	0.0	0.0	0.8	9.8	15.1	21.5	20.2	10.6	0.7	0.0	0.0	0.0	78.7
Mean no. days with temp. less than 32°F	4.8	1.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	4.7	12.3

(1) Period of record is 65 years (1913-1977) unless otherwise noted

(2) Period of record is 93 years

Table 2.1-2 Annual Wind Speed-Wind Direction Distribution for
 Page 1 Stability Class 1 - Valdosta, Georgia 1972-1976

Wind Direction	Windspeed (m/sec)					
	0-1.5	1.6-3	4-5	6-8	9-11	> 11
N	0.0005	0.000	0.0	0.0	0.0	0.0
NNE	0.0004	0.0007	0.0	0.0	0.0	0.0
NE	0.0004	0.0006	0.0	0.0	0.0	0.0
ENE	0.0003	0.0005	0.0	0.0	0.0	0.0
E	0.0006	0.0008	0.0	0.0	0.0	0.0
ESE	0.0005	0.0005	0.0	0.0	0.0	0.0
SE	0.0007	0.0009	0.0	0.0	0.0	0.0
SSE	0.0003	0.0004	0.0	0.0	0.0	0.0
S	0.0005	0.0007	0.0	0.0	0.0	0.0
SSW	0.0003	0.0004	0.0	0.0	0.0	0.0
SW	0.0004	0.0007	0.0	0.0	0.0	0.0
WSW	0.0005	0.0008	0.0	0.0	0.0	0.0
W	0.0007	0.0010	0.0	0.0	0.0	0.0
WNW	0.0004	0.0007	0.0	0.0	0.0	0.0
NW	0.0003	0.0006	0.0	0.0	0.0	0.0
NNW	0.0003	0.0005	0.0	0.0	0.0	0.0

Table 2.1-2 Annual Wind Speed-Wind Direction Distribution for
Page 2 Stability Class 2 - Valdosta, Georgia 1972-1976

Wind Direction	Windspeed (m/sec)					
	0-1.5	1.6-3	4-5	6-8	9-11	> 11
N	0.0015	0.0045	0.0022	0.0	0.0	0.0
NNE	0.0011	0.0028	0.0012	0.0	0.0	0.0
NE	0.0010	0.0027	0.0016	0.0	0.0	0.0
ENE	0.0015	0.0035	0.0019	0.0	0.0	0.0
E	0.0014	0.0042	0.0017	0.0	0.0	0.0
ESE	0.0009	0.0029	0.0013	0.0	0.0	0.0
SE	0.0011	0.0029	0.0013	0.0	0.0	0.0
SSE	0.0009	0.0022	0.0010	0.0	0.0	0.0
S	0.0012	0.0034	0.0013	0.0	0.0	0.0
SSW	0.0008	0.0022	0.0012	0.0	0.0	0.0
SW	0.0008	0.0026	0.0014	0.0	0.0	0.0
WSW	0.0009	0.0025	0.0020	0.0	0.0	0.0
W	0.0012	0.0038	0.0026	0.0	0.0	0.0
WNW	0.0008	0.0033	0.0019	0.0	0.0	0.0
NW	0.0009	0.0026	0.0014	0.0	0.0	0.0
NNW	0.0008	0.0024	0.0011	0.0	0.0	0.0

Table 2.1-2 Annual Wind Speed-Wind Direction Distribution for
 Page 3 Stability Class 3 - Valdosta, Georgia 1972-1976

Wind Direction	Windspeed (m/sec)					
	0-1.5	1.6-3	4-5	6-8	9-11	>11
N	0.0005	0.0037	0.0066	0.0004	0.0	0.0
NNE	0.0005	0.0028	0.0050	0.0003	0.0	0.0
NE	0.0005	0.0031	0.0059	0.0005	0.0	0.0
ENE	0.0004	0.0034	0.0067	0.0006	0.0	0.0
E	0.0006	0.0043	0.0065	0.0006	0.0	0.0
ESE	0.0007	0.0029	0.0039	0.0004	0.0	0.0
SE	0.0004	0.0032	0.0030	0.0001	0.0	0.0
SSE	0.0003	0.0022	0.0027	0.0001	0.0	0.0
S	0.0009	0.0034	0.0058	0.0006	0.0	0.0
SSW	0.0003	0.0021	0.0035	0.0005	0.0	0.0
SW	0.0004	0.0024	0.0055	0.0008	0.0	0.0
WSW	0.0003	0.0026	0.0056	0.0009	0.0	0.0
W	0.0005	0.0039	0.0058	0.0006	0.0	0.0
WNW	0.0004	0.0027	0.0051	0.0004	0.0	0.0
NW	0.0004	0.0028	0.0050	0.0004	0.0	0.0
NNW	0.0003	0.0023	0.0041	0.0006	0.0	0.0

Table 2.1-2 Annual Wind Speed-Wind Direction Distribution for
Page 4 Stability Class 4 - Valdosta, Georgia 1972-1976

Wind Direction	Windspeed (m/sec)					
	0-1.5	1.6-3	4-5	6-8	9-11	> 11
N	0.0014	0.0052	0.0112	0.0059	0.0002	0.0
NNE	0.0011	0.0044	0.0083	0.0027	0.0000	0.0
NE	0.0011	0.0060	0.0130	0.0048	0.0001	0.0
ENE	0.0018	0.0079	0.0121	0.0042	0.0001	0.0
E	0.0020	0.0092	0.0134	0.0041	0.0001	0.0
ESE	0.0016	0.0062	0.0072	0.0023	0.0001	0.0
SE	0.0015	0.0046	0.0050	0.0010	0.0000	0.0
SSE	0.0008	0.0040	0.0050	0.0018	0.0002	0.0
S	0.0021	0.0082	0.0159	0.0094	0.0011	0.0
SSW	0.0011	0.0053	0.0117	0.0091	0.0006	0.0
SW	0.0013	0.0061	0.0117	0.0094	0.0011	0.0
WSW	0.0010	0.0046	0.0076	0.0046	0.0002	0.0
W	0.0009	0.0045	0.0062	0.0049	0.0004	0.0
WNW	0.0009	0.0038	0.0042	0.0053	0.0002	0.0
NW	0.0010	0.0033	0.0053	0.0047	0.0001	0.0
NNW	0.0006	0.0027	0.0050	0.0033	0.0001	0.0

Table 2.1-2 Annual Wind Speed-Wind Direction Distribution for
page 5 Stability Class 5 - Valdosta, Georgia 1972-1976

Wind Direction	Windspeed (m/sec)					
	0-1.5	1.6-3	4-5	6-8	9-11	> 11
N	0.0128	0.0129	0.0055	0.0	0.0	0.0
NNE	0.0104	0.0097	0.0030	0.0	0.0	0.0
NE	0.0119	0.0149	0.0035	0.0	0.0	0.0
ENE	0.0130	0.0152	0.0025	0.0	0.0	0.0
E	0.0140	0.0170	0.0049	0.0	0.0	0.0
ESE	0.0097	0.0113	0.0027	0.0	0.0	0.0
SE	0.0099	0.0092	0.0009	0.0	0.0	0.0
SSE	0.0087	0.0077	0.0004	0.0	0.0	0.0
S	0.0143	0.0140	0.0023	0.0	0.0	0.0
SSW	0.0112	0.0130	0.0035	0.0	0.0	0.0
SW	0.0160	0.0177	0.0054	0.0	0.0	0.0
WSW	0.0110	0.0115	0.0030	0.0	0.0	0.0
W	0.0112	0.0121	0.0018	0.0	0.0	0.0
WNW	0.0090	0.0103	0.0023	0.0	0.0	0.0
NW	0.0079	0.0080	0.0027	0.0	0.0	0.0
NNW	0.0070	0.0082	0.0033	0.0	0.0	0.0

Table 2.1-2 Annual Wind Speed-Wind Direction Distribution for
Page 6 All Stability Classes - Valdosta, Georgia 1972-1976

Wind Direction	Windspeed (m/sec)					
	0-1.5	1.6-3	4-5	6-8	9-11	> 11
N	0.0170	0.0269	0.0254	0.0063	0.0002	0.0
NNE	0.0135	0.0204	0.0174	0.0030	0.0000	0.0
NE	0.0145	0.0272	0.0240	0.0053	0.0001	0.0
ENE	0.0174	0.0305	0.0231	0.0048	0.0001	0.0
E	0.0192	0.0355	0.0266	0.0046	0.0001	0.0
ESE	0.0139	0.0238	0.0151	0.0027	0.0001	0.0
SE	0.0139	0.0208	0.0102	0.0011	0.0000	0.0
SSE	0.0110	0.0165	0.0091	0.0020	0.0002	0.0
S	0.0193	0.0297	0.0253	0.0100	0.0011	0.0
SSW	0.0131	0.0229	0.0198	0.0096	0.0006	0.0
SW	0.0175	0.0294	0.0239	0.0103	0.0011	0.0
WSW	0.0133	0.0220	0.0182	0.0055	0.0002	0.0
W	0.0144	0.0253	0.0164	0.0055	0.0004	0.0
WNW	0.0116	0.0208	0.0135	0.0057	0.0003	0.0
NW	0.0107	0.0172	0.0143	0.0051	0.0001	0.0
NNW	0.0090	0.0161	0.0135	0.0039	0.0004	0.0

Table 2.1-3 Dew Point Depression and Relative Humidity at Various Air Temperatures to Give a Deficit Between Actual and Saturation Humidity of ≤ 0.1 gram/meter

Dry Bulb Temperature (°C)	Dry Bulb Temperature (°F)	Relative Humidity (%)	Dew Point Depression Below Dry Bulb Temperature (°F)
>18	>65	99	0.2
16	60	99	0.3
13	55	99	0.4
10	50	99	0.4
4	40	98	0.5
-1	30	98	0.6
-7	20	96	0.9
-12	10	94	1.3

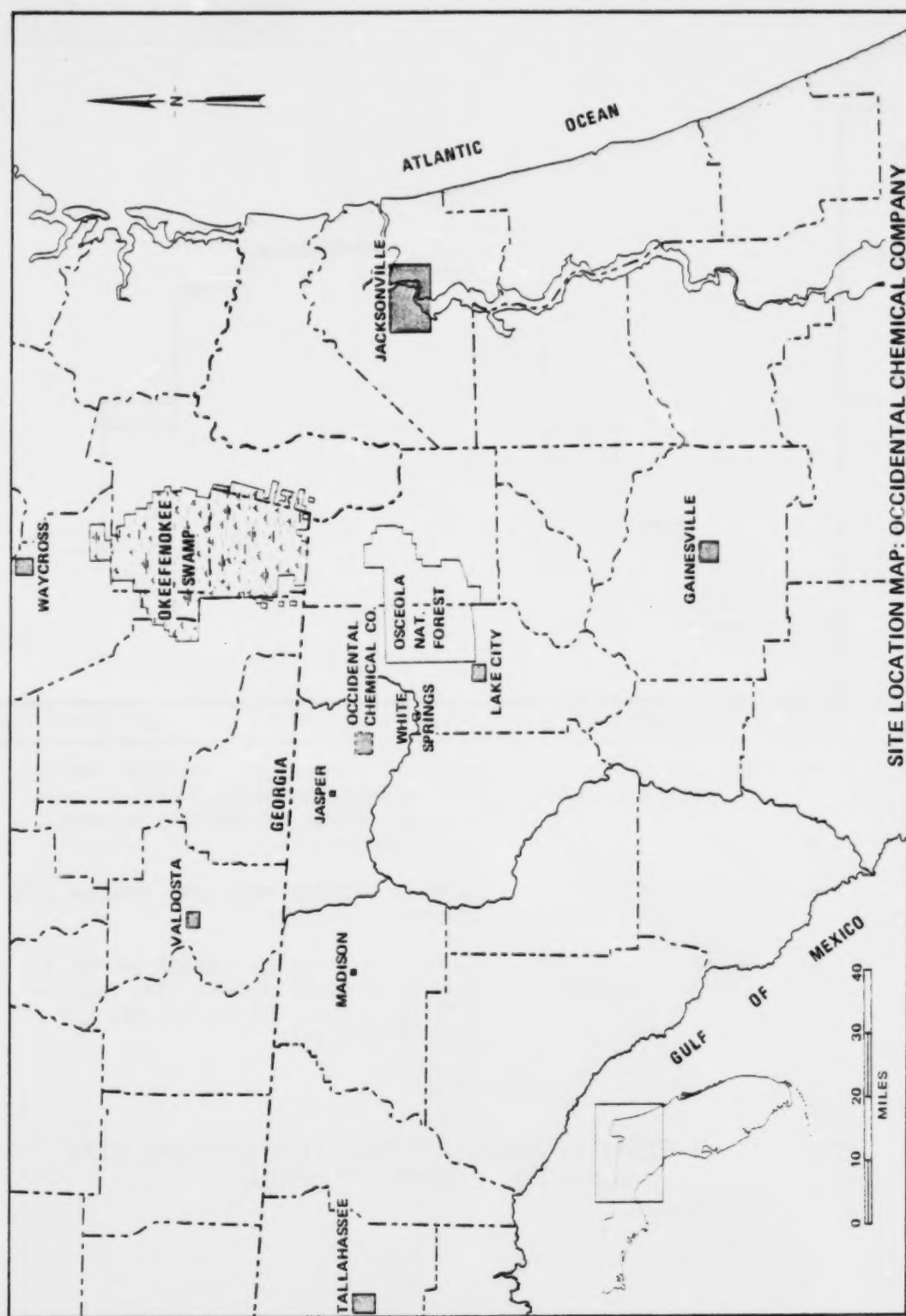
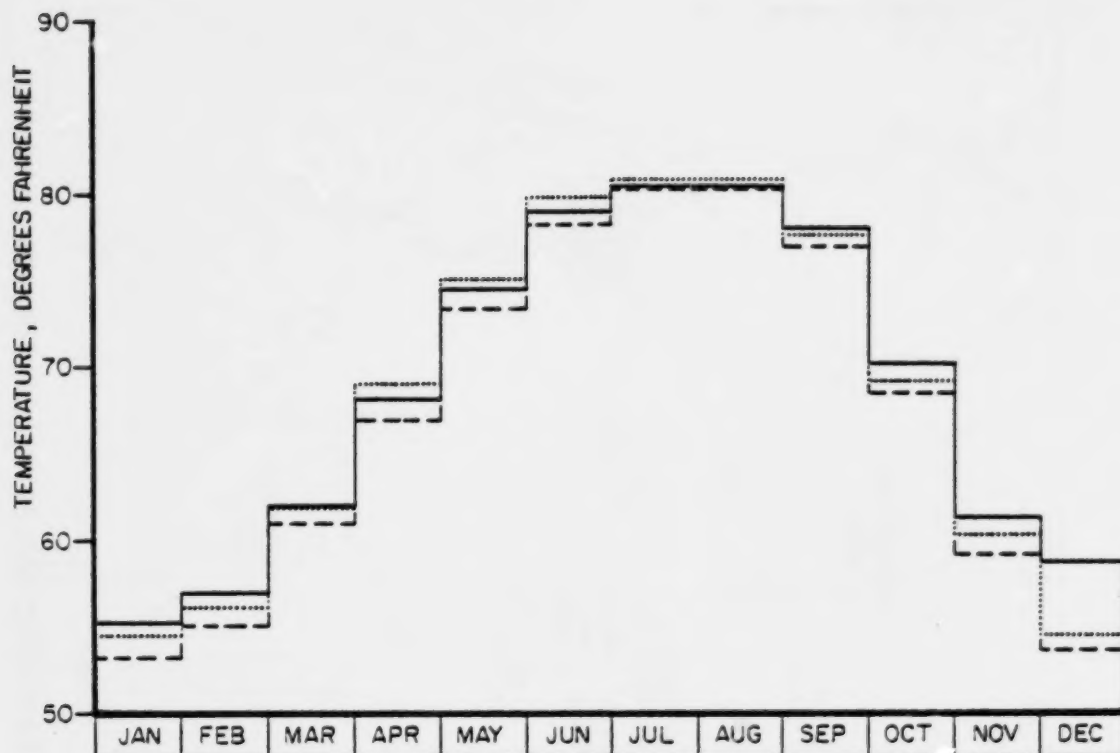


FIGURE 2.1-1

STATION	LONG-TERM AVERAGE TEMPERATURE
LAKE CITY	68.6° F
JASPER	67.5° F
MADISON	68.5° F



— LAKE CITY
COLUMBIA COUNTY

BASED ON A WEIGHTED AVERAGE OF THE 30 YEAR TEMPERATURE NORMALS 1941 THROUGH 1970 AND ANNUAL TEMPERATURE RECORDS 1971 THROUGH 1976.

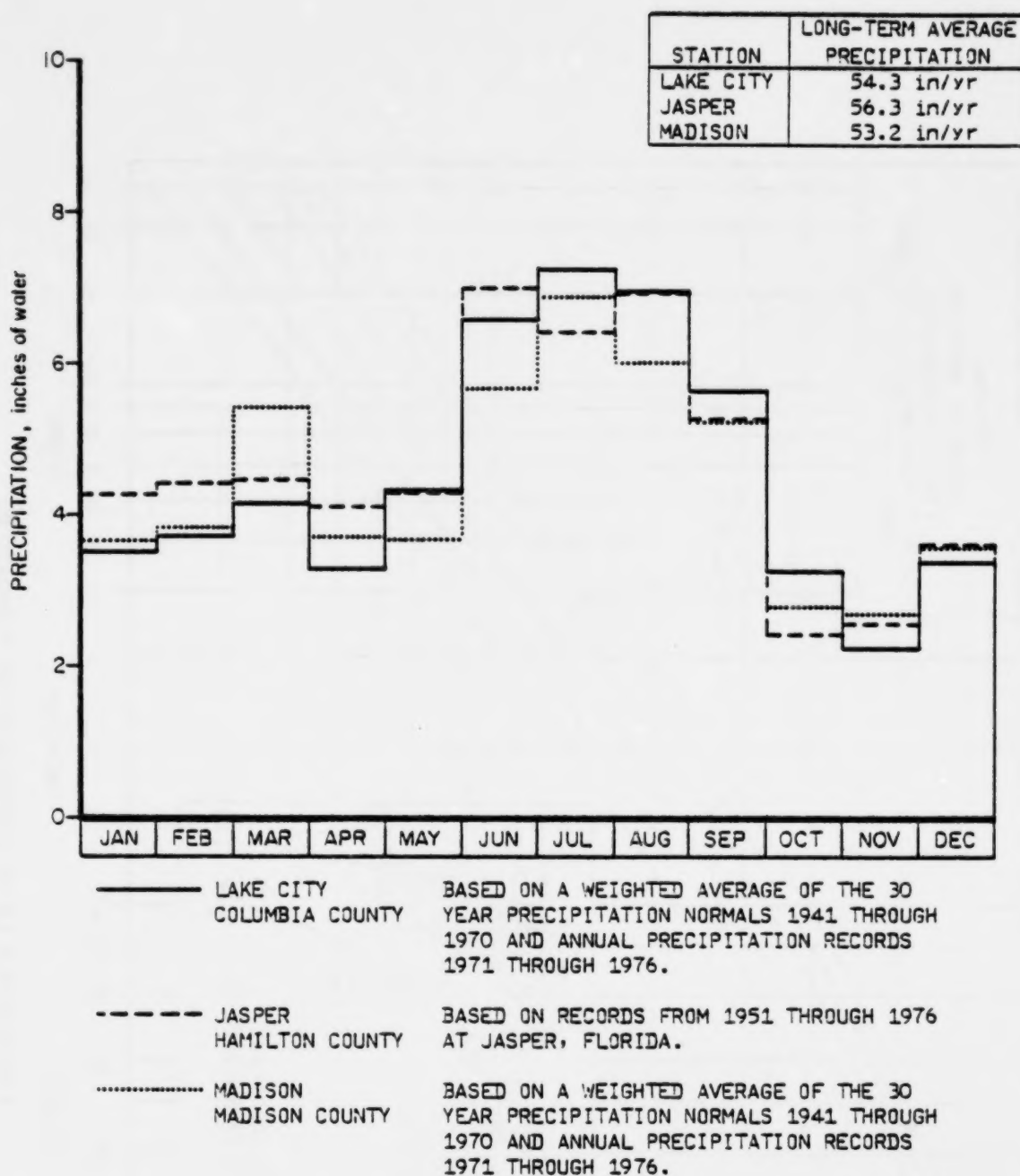
- - - JASPER
HAMILTON COUNTY

BASED ON RECORDS FROM 1951 THROUGH 1976 AT JASPER, FLORIDA.

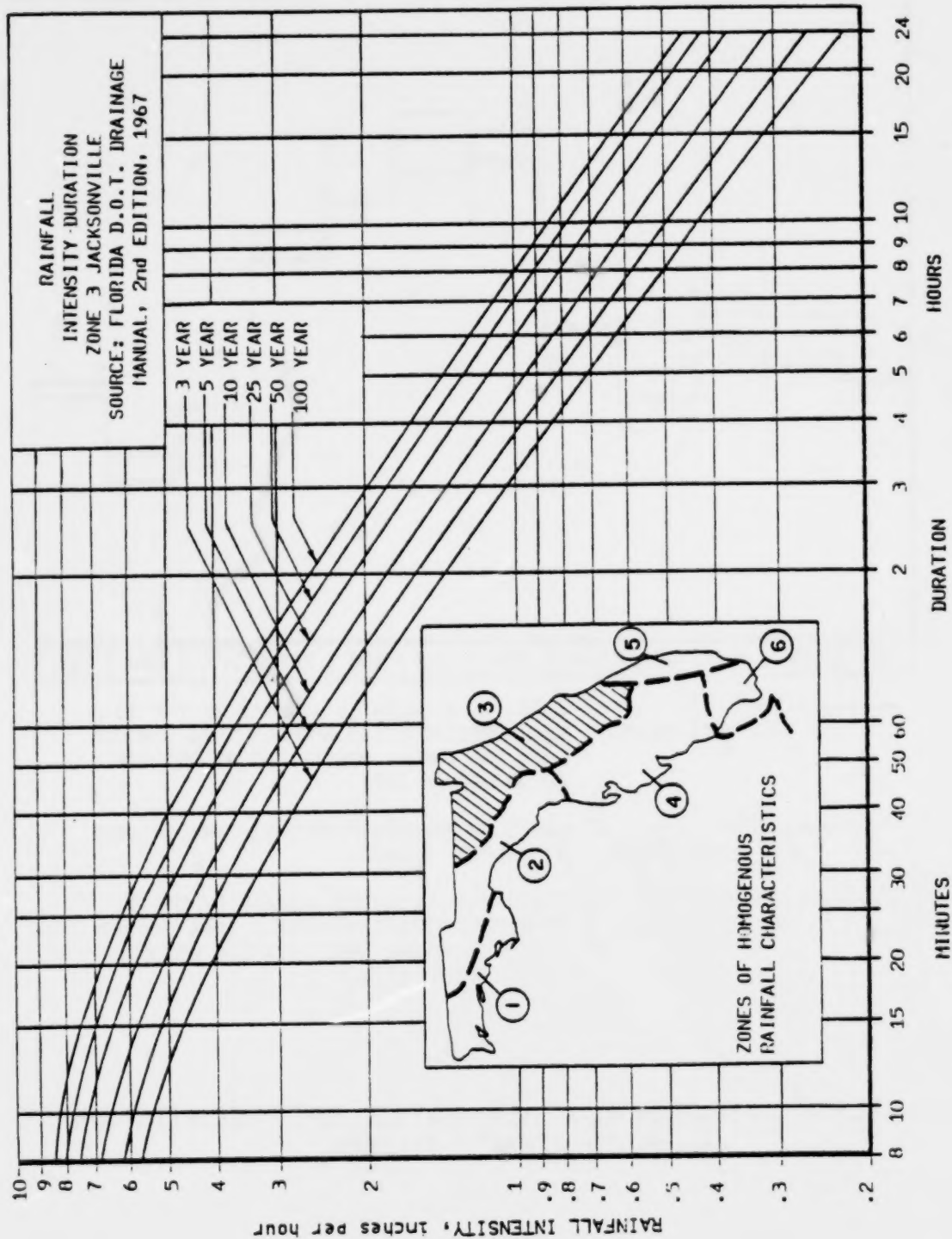
..... MADISON
MADISON COUNTY

BASED ON A WEIGHTED AVERAGE ON THE 30 YEAR TEMPERATURE NORMALS 1941 THROUGH 1970 AND ANNUAL TEMPERATURE RECORDS 1971 THROUGH 1976.

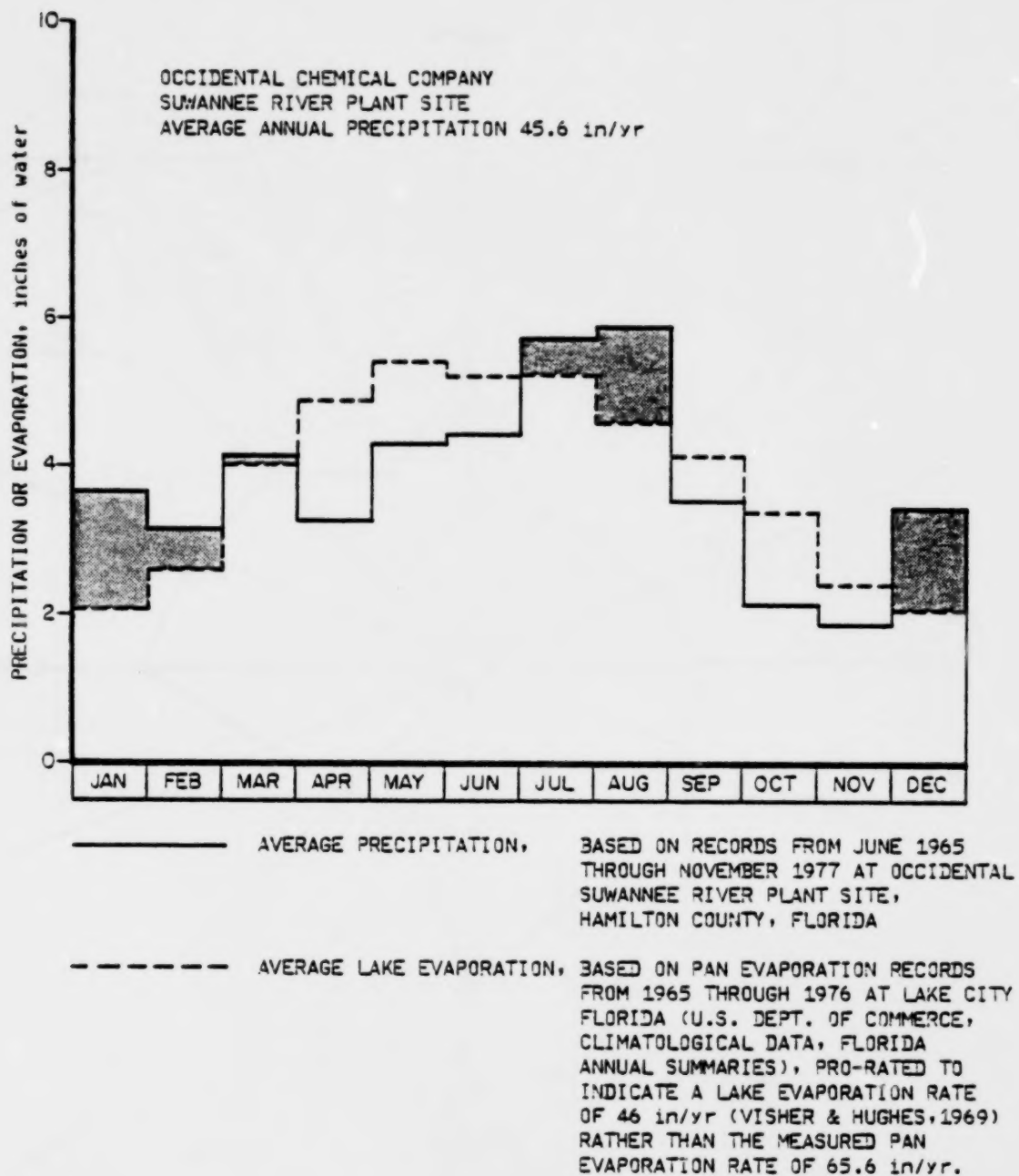
LONG-TERM AVERAGE MONTHLY TEMPERATURE DATA HAMILTON COUNTY, FLORIDA



LONG-TERM AVERAGE MONTHLY RATES OF PRECIPITATION
HAMILTON COUNTY, FLORIDA



FREQUENCY OF OCCURRENCE OF STORMS IN
HAMILTON COUNTY, FLORIDA



MONTHLY DISTRIBUTION
OF AVERAGE RATES OF EVAPORATION AND PRECIPITATION
AT THE OCCIDENTAL SUWANNEE RIVER PLANT

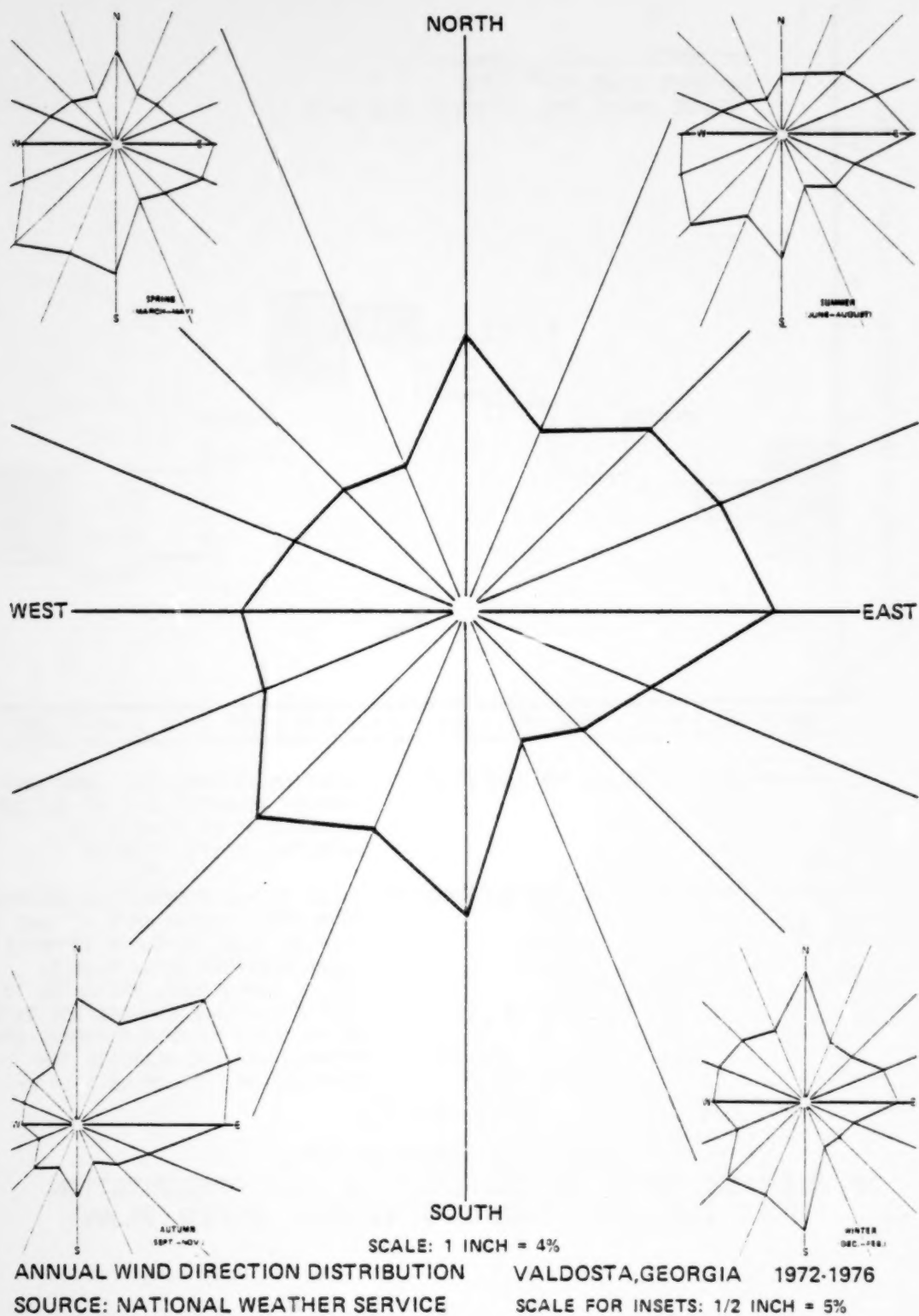


FIGURE 2.1-6

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2.2 AIR QUALITY

Pre-construction air quality was established for the 1977-78 period; the air quality existing at the time of preparation of this report.

The pollutants considered in defining air quality are sulfur dioxide (SO_2), total suspended particulate matter (TSP), carbon monoxide (CO), nitrogen oxides (NO_x), hydrocarbons, and fluorides. The only pollutants emitted in significant quantities by existing and proposed sources in the Hamilton County area are SO_2 , TSP and fluorides.

It should be noted that EPA was furnished the information required to conduct a New Source Review and a Prevention of Significant Deterioration of air quality review in November 1977. These materials were reviewed and approved in February 1978.

The procedure used for establishing ambient levels of SO_2 and TSP was air quality modeling. Measured levels of these pollutants in the ambient air were used to establish background levels of the pollutants and to confirm, in a general manner, model performance. The procedure for establishing the pre-construction impact of fluoride emissions involved a combination of ambient measurements and the observation sensitive receptors. Only the emission burdens were compiled for CO, NO_x and hydrocarbons since these contaminants are emitted in small quantities throughout the study area.

2.2.1 METHODOLOGY

The development of an emission inventory for sulfur dioxide and particulate emissions and the subsequent evaluation of the impact of these emissions by air quality modeling was relatively straightforward. These pollutants are emitted from well defined sources and the emission rate of each could be determined with a reasonable degree of accuracy by measurement or by calculation from process parameters. Since the source of these two pollutants could readily be estimated with suitable air quality models.

The evaluation of fluoride emissions presented some major difficulties, however. In a phosphate fertilizer complex there are several processes which emit fluorides. These include the phosphoric acid plants, superphosphoric acid plants, granular fertilizer process plants, and storage facilities for granular products. As with particulate matter and sulfur dioxide, the fluoride emissions from these sources could be measured and the source of emissions well defined. The impact of these emissions on ambient air quality could likewise be reasonably estimated with air quality models.

The problem in estimating total facility fluoride emissions develops because of emissions from the cooling water ponds and gypsum ponds. Various studies have resulted in estimates of fluoride emissions from these ponds ranging from 0.1 to 10 pounds of fluoride per acre per day. Because of the uncertainty in establishing an emission rate for ponds

and the fact that these emissions might account for anywhere between 14 and 94 percent of the total fluoride emissions from a phosphate fertilizer complex, an alternative approach was used for establishing existing fluoride impact. Another factor complicating the analysis of these emissions is that emissions from a pond surface cannot as yet be simulated with air quality models.

The impact of existing fluoride emissions was defined in terms of:

1. measured ambient air fluoride concentrations;
2. measured fluoride concentrations in grass;
3. observed effects of fluorides on cattle; and
4. observed effects of fluoride on vegetation.

The emission burdens of CO, NO_x and hydrocarbons were estimated for the Hamilton County area using emission factors developed by EPA (1976).

2.2.1.1 Air Quality Modeling Methodology

Air quality modeling to establish pre-construction levels of SO₂ and TSP was conducted in accordance with guidelines published by the U.S. Environmental Protection Agency (EPA 1977).

The modeling procedures involved the development of a five year meteorological data base and the development of an emission inventory for SO₂ and TSP. These data were input into appropriate air quality models to establish annual average and short-term levels of the two pollutants.

An earlier study established that meteorological data from Valdosta, Georgia were more representative of the Occidental site than meteorological data from other sources in the area. (Sholtes & Koogler Environmental Consultants, Dec. 1977). This study also showed that the closest and most representative upper air data for the Occidental site could be obtained from the National Weather Service Station in Waycross, Georgia. As a result of this study, surface observations for Valdosta, Georgia and upper air data from Waycross, Georgia for the period 1972 through 1976 were obtained from the National Oceanographic and Atmospheric Administration, National Weather Service, Asheville, N.C.

These data were prepared in the proper format and processed with the pre-processor program associated with the CRSTER air quality model. The surface observations from Valdosta, Georgia were also processed into in the STAR format compatible with the Air Quality Display Model (AQDM).

Emission inventories were prepared for SO_2 and particulate matter for the period 1977-78. A previous study showed that the only sources of particulate matter and SO_2 impacting significantly on the Occidental site were those sources owned and operated by Occidental Chemical Company (Environmental Science & Engineering, Inc., Nov. 1974). Air quality monitoring for SO_2 and TSP confirmed that the Occidental sources were the only point sources of these pollutants impacting on the area.

For all Occidental sources an annual average emission rate and a short-term maximum emission rate for SO_2 and particulate matter was determined. The maximum emission rates were determined by emission measurements or were calculated from known process variables. The annual average emission rates were calculated from the maximum emission rates taking into account annual average production rates and the fraction of time each source operated during an annual period.

The annual average and short-term particulate matter emission data from the Occidental sources for the 1977-78 period are presented in Table 2.2-1. The SO_2 emission data for the 1977-78 period are presented in Table 2.2-2.

The air quality models used for the study were the CRSTER, the PTMPW, and the AQDM. The CRSTER was used with hourly meteorological data from the five year period 1972 through 1976. This model was run four times; once for each of the following sets of emission data:

1. 1977-78 SO_2 emission data from the existing Suwannee River Chemical Complex;
2. 1977-78 SO_2 emission data from the proposed Swift Creek complex;
3. 1977-78 particulate matter emissions from the Suwannee River Chemical Complex; and
4. 1977-78 particulate matter emission data from the Proposed Swift Creek complex.

This model generated highest and second-highest 24-hour and 3-hour pollutant concentrations at five receptors in each of 36 directions from the Suwannee River site and the Swift Creek site. The 36 directions corresponded to every 10 degrees of the compass; e.g., 10°, 20°, 30°, etc.

Since five years of meteorological data were used in the evaluation the second highest concentrations in each of several directions were selected for further evaluation with the air quality model PTMTPW.

The conditions selected for further evaluation included the highest second-high 24-hour conditions for particulate matter and SO₂ and 3-hour conditions for SO₂. These time periods correspond to applicable state and federal air quality standards. Other conditions evaluated represented the highest second-high concentrations in directions representing various source alignments. In evaluating these conditions, the receptor at which the maximum impact occurred was isolated. Receptor spacings of 0.1 kilometer were used in determining the maximum impacts.

The meteorological data corresponding to all conditions selected for study plus the applicable short-term emission data were input into the PTMTPW. This model was used with the Briggs plume rise equation and a calibration of 1.0.

Annual average periods for SO₂ and TSP were simulated with the Air Quality Display Model (AQDM). This model was used with the five year

summary of Valdosta meteorological data (1972-1976) and the annual average emission inventory for particulate matter and SO_2 . The model was used with the Briggs plume rise equation and a calibration factor of 1.0.

2.2.2 EXISTING AIR QUALITY

Pre-construction air quality for the 1977-78 time period was determined for SO_2 and TSP by air quality modeling and ambient air quality monitoring. Ambient fluoride levels in ambient air and grass were monitored during the 1977-78 period. Surveys were made in 1977 and 1978 to determine the effects of fluorides on vegetation and in 1978 to determine the effect of fluorides on cattle.

2.2.2.1 Existing Sulfur Dioxide Levels

Ambient levels of SO_2 in the study area were determined by air quality modeling techniques for the 1977-78 period. In addition to these calculated levels, ambient SO_2 levels have been measured at four sites with continuous monitoring instrumentation since May 1977. The instruments used have been Meloy Model SA-285 flame photometric SO_2 monitors.

2.2.2.1.1 Calculated Sulfur Dioxide Levels -- Ambient SO_2 levels were calculated for annual 24-hour and 3-hour periods using procedures described in Section 2.2.1.1.

The calculated SO_2 concentrations are presented in tabular and graphical form. Isopleths of annual average SO_2 concentrations for the 1977-78

period are presented as Figure 2.2-1. The data from this figure are summarized in Table 2.2-3. The calculated SO₂ levels for the 24-hour period and 3-hour period are presented in Figures 2.2-2 and 2.2-3. The data from these figures are also summarized in Table 2.2-3.

The maximum calculated annual SO₂ level for the 1977-78 time period was 20 micrograms per cubic meter. This level occurred approximately 1.5 kilometers due west of the existing chemical complex. It is well below the FDER annual SO₂ standard of 60 micrograms per cubic meter.

The second-highest predicted 24-hour SO₂ concentration for the study area occurs one kilometer northwest of the existing chemical complex. This level is below the FDER 24-hour SO₂ standard of 260 µg/m³ and the federal standard of 365 µg/m³. This level resulted from emissions from the existing chemical complex.

The calculated second-highest 3-hour SO₂ level for the 1977-78 period was calculated to be 1214 µg/m³. This compares to the federal and Florida 3-hour SO₂ air quality standard of 1300 µg/m³. The highest 3-hour SO₂ level calculated at the Swift Creek site was only 35 µg/m³.

2.2.2.1.2 Measured Sulfur Dioxide Levels -- Ambient air monitoring for SO₂ has been conducted by Occidental Chemical Company since 1973. As a result of these studies a considerable volume of ambient data have been collected. Unfortunately, most of the data were collected with bubbler

samplers without temperature control. These data are suspect, therefore, because of the temperature sensitivity of the West-Gaeke monitoring method reported by EPA in December 1975 (EPA, 1975). The data do provide, however, information on the sites where the greatest number of elevated SO_2 exposures were experienced. Based on these data and information developed through previous air quality modeling studies, four continuous SO_2 monitors were installed in May 1977. The location of these monitors is shown in Figure 2.2-4.

These monitors have operated continually since May 1977. Even though the SO_2 data collected in this network were not for purposes of this impact statement, the data have been summarized through January 1978 and presented as Table 2.2-4. These data substantiate that the background SO_2 level is zero. The only time an exposure is recorded is when the wind is blowing from one of the Occidental SO_2 sources toward a monitoring site.

The data show that the long-term arithmetic mean SO_2 level is quite low; in the range of 1 to 17 micrograms per cubic meter. The 17 microgram per cubic meter level recorded at site No. 7 is biased high because of periods of sulfuric acid plant upset. If these periods are eliminated the long-term mean SO_2 level for site No. 7 is 9.8 micrograms per cubic meter.

The highest measured 24-hour SO_2 level under periods of normal plant operation was 197 micrograms per cubic meter. The highest second-high measured 24-hour SO_2 level was 85 micrograms per cubic meter.

2.2.2.2 Existing and Baseline Total Suspended Particulate Matter Levels

Total suspended particulate matter (TSP) levels in the study area were determined by air quality modeling techniques for the 1977-78 period. In addition to the air quality modeling, TSP levels have been monitored in the area since October 1975. The TSP levels have been monitored at six sites with the high volume sampler method in accordance with guidelines set forth by EPA (40 CFR 50, Appendix B).

2.2.2.2.1 Calculated Total Suspended Particulate Matter Levels --

Ambient TSP levels were established for the time period 1977-78 using air quality modeling techniques. The annual average TSP levels were determined and the second-highest expected 24-hour TSP levels at several points were calculated. The modeling techniques used are described in Section 2.2.1.1.

Annual average TSP levels for 1977-78 period are presented as Figure 2.2-5. These data are also summarized in Table 2.2-5. During the 1977-78 period, the highest annual average TSP level for the area was $34 \mu\text{g}/\text{m}^3$. This level compares with an FDER standard of $60 \mu\text{g}/\text{m}^3$ and a federal standard of $75 \mu\text{g}/\text{m}^3$.

The second-highest expected 24-hour TSP levels for several locations are presented in Figure 2.2-6. The locations for which particulate matter levels were calculated were selected to illustrate the compounding effects of emissions from various sources created with different wind

directions. In addition, receptors were selected to show the TSP levels created by the second worst case dispersion conditions for the Swift Creek and Suwannee River sites. These data are also summarized in Table 2.2-5.

It will be noted from Figure 2.2-6 that the second-high calculated 24-hour TSP level occurs just west of the existing chemical complex on Occidental property. During the 1977-78 period this level was projected to be 116 micrograms per cubic meter including 61 micrograms per cubic meter of background particulate matter. This compares with a FDER standard of 150 micrograms per cubic meter and a federal standard of 260 micrograms per cubic meter.

At the proposed Swift Creek chemical complex site the second-highest projected 24-hour total suspended particulate matter level for the 1977-78 period is 77 micrograms per cubic meter. This is the result of particulate matter emissions from the existing phosphate rock beneficiation plant located near that site.

2.2.2.2.2 Measured Ambient Total Suspended Particulate Matter Levels -- TSP levels have been monitored at the Occidental site since October 1975 and the program is continuing. Measurements have been made at six sites shown in Figure 2.2-4. The sampling method used is the high-volume sampling method specified by EPA (40 CFR 50, Appendix B). At the present time monitoring is being conducted at only four of these sites; those

identified as 4, 5, 6 and 7. The data show 24-month geometric mean levels of TSP ranging from 25 to 45 micrograms per cubic meter. Individual concentrations ranged from 5 to 757 micrograms per cubic meter. The extreme high concentration and other high levels measured on February 24, 1977 were due to a large scale dust cloud passing over north Florida. The presence of this cloud was confirmed by high volume samplers located throughout northern and central Florida. A summary of the TSP data is presented in Table 2.2-6.

The data show that the second high expected TSP levels range from 69 to 148 micrograms per cubic meter. A review of the geographic location of the sites reveals that Sites 1, 2, 5 and 6 can be considered representative of background TSP conditions. These sites are removed from point and fugitive sources of particulate matter. Only limited data were available for Site 6 however, therefore Sites 1, 2 and 5 were selected to be representative of background TSP conditions.

The 24-month geometric mean TSP concentration from Sites 1, 2 and 5 collectively was 31 micrograms per cubic meter. This concentration was selected as the annual average background TSP level.

To establish a background TSP level for a 24-hour period the 95th percentile TSP concentration of sites 1, 2 and 5, collectively, was selected. This concentration, calculated by taking the geometric mean of the 95th percentile concentration from each of the three sites, is 61 micrograms per cubic meter.

2.2.2.3 Existing Fluoride Data

2.2.2.3.1 Fluoride Emission Inventory -- Since the impact of existing fluoride emissions was evaluated in terms of measured ambient concentrations of fluoride and observed fluoride effects, only the total fluoride emission burden was calculated for the existing chemical complex.

In a phosphate fertilizer complex, fluoride emissions result from unit processes and from cooling water ponds and gypsum ponds. Fluoride emissions from point sources were determined from permitted emission rates established by the Florida Department of Environmental Regulation. The permitted emission rate for the complex averages 0.20 pounds of fluoride per tons of P_2O_5 fed to the phosphoric acid plants. The permitted P_2O_5 feed rate to existing phosphoric acid plants is 1895 tons per day making the permitted daily fluoride emission rate 379 pounds.

The second source of fluoride emissions is gypsum and cooling water ponds. While differences of opinion exist with respect to the magnitude of these emissions, it is generally agreed that some fluorine reaches the gypsum pond and cooling water pond circuits and that some quantity of this material escapes into the ambient air.

A thorough examination of this subject was recently performed under EPA Contract No. 68-02-1330 Task No. 3 and reported under the title: "Evaluation of Emissions and Control Techniques for Reducing Fluoride

Emissions from Gypsum Ponds in the Phosphoric Acid Industry". This paper was broad in its scope and included a detailed examination of at least three published investigations on the quantification of fluoride emissions from gypsum ponds. In this report generous use will be made of the referenced EPA sponsored work.

Part of the EPA report deals with gypsum pond chemistry and includes the following conclusions (Section 3.5):

"The development of the model of fluoride interactions presented in Figure 3.7 is based on little quantitative information. Available literature is deficient in the quantitative information necessary to evaluate this complex chemical solution. The model is based on several very qualitative assumptions concerning the significance of particular chemical reactions. Some reasonably detailed analytical data would be required to substantiate the conclusions drawn. Nevertheless, there appears to be little to support the contention that significant quantities of fluoride are emitted to the atmosphere by volatilization from the gypsum pond surface. This results from two conclusions:

a) relatively little free HF and even less SiF_4 , the only measurably volatile fluoride species, are present in the gypsum pond waters, and b) $\text{HF}_{(\text{aq})}$ is of low volatility.

At least one of the assumptions used in arriving at this conclusion is supported by evidence available to the authors. Laboratory analysis of fluoride species in gypsum pond waters has indicated in excess of 80 percent is in the form of fluosilicic acid, H_2SiF_6 . One other empirical observation bearing on the qualitative conclusions reached is that recycled gypsum pond water is used in the scrubbers which are designed to remove HF which is volatilized during several process steps. If these recycled waters have an HF concentration such that a significant quantity would be likely to volatilize in the pond environment, it is highly unlikely that these same waters would be effective in absorbing airborne HF in the scrubbers." (EPA undated)

As mentioned above the EPA report examined three published investigations which, at the time, represented the majority of known data on the subject. The first report reviewed was the report of Frank L. Cross, Jr., of the Manatee County Health Department, Bradenton, Florida in 1967.

The maximum value determined by Cross was 0.161 lb/acre-day. Quoting from Section 4.1.3 of the EPA report:

"The first point to make concerning Cross' study is that no attempt was made to determine the parameters which influence gypsum pond emissions. No parameters were varied throughout the experiment which entered the emission calculation, except for the fluoride concentration measured within the greenhouse. However, the intention of his experiment was not to conduct an elaborate study, but to practically measure an emission rate of that pond during normal operation conditions.

As shown in Figure 4.1, air from the northeast would have traversed approximately the same distance over the water on reaching the greenhouse sampler as on reaching the on-shore sampler. Thus one would expect the fluoride concentration in the greenhouse to be the same as that measured on shore provided the air flow through the greenhouse was at the proper rate.

Cross assigned an arbitrary area (A_g) and an arbitrary flow rate (Q) to his system and to determine an emission rate multiplied the flow rate by the fluoride concentration and divided by the projected area. Had the area been twice as great, Q and C_g would have been approximately the same as before and an emission rate equal to half of that obtained before would have measured. Similarly, had Q been doubled, A_g and C_g would have remained unchanged and an emission factor twice as great would have been obtained.

The conclusion is that fundamental errors caused by using an arbitrary area and flow rate render the results meaningless. No judgments can be made regarding accuracy of results since the method used is totally invalid. (EPA undated)

The second study examined was a Ph.D., dissertation presented by Bernard S. Tatera in 1970 to the University of Florida, Department of Environmental Engineering, entitled: "Parameters Which Influence Fluoride Emissions from Gypsum Ponds". Tatera's study was laboratory based and did not attempt field measurements. The EPA report deals with these data in the following quote from Section 4.2.3:

"Tatera designed his experiment with some knowledge of the parameters that affect emissions, i.e., wind velocity, temperature and concentration. He developed vapor pressure

data at various different liquid fluoride concentrations (equations 4.1-4.12), which indicated higher vapor pressures of fluorides when fluoride concentrations were increased in the liquid phase. Generally these were linear relationships, in accordance with Henry's Law:

$$P_f = HX_f \quad 4.18$$

where: P_f = partial pressure of fluoride in vapor phase (mm Hg)

H = Henry's constant of proportionality (mm Hg⁻¹)

X_f = molar fraction of fluorides in liquid phase

Perhaps the most nearly applicable equations are 4.7 through 4.9 which are for the system H₂SiF₆ pond water. It is unfortunate that Tatera was not able to incorporate these correlations into his emission factor. His emission rates were therefore given as functions of velocity and temperature. His technique appears experimentally sound and is a good practical in-laboratory approach. His studies served as an estimate of fluoride emissions from gypsum ponds. However, the results are not immediately applicable to large scale systems, i.e., a real gypsum pond. As Tatera himself states, the problem of relating what happens in a wind tunnel to what occurs in the natural atmosphere is very difficult.

Secondly, there are no generally accepted hydrodynamic scaling criteria which allow the evaluation of the suitability of prototypes in wind tunnels to actual concentrations.

One deficiency in Tatera's study is that the wind speed was measured at 0.1 meters above the surface. It can be readily appreciated that since there is a well developed velocity profile in real systems, the velocities measured at 0.1 meters above the surface should be readjusted to conform with velocities that would be recorded by a met tower or ambient wind measuring device. Therefore, when an emission rate is calculated at a given velocity using equations 4.15 through 4.17, an erroneously high emission rate will be obtained unless wind speeds are scaled down using the appropriate velocity profile relationships. These corrections are discussed in Section 4.4 of this report." (EPA undated)

Emission factors from Tatera ranged from near zero to 7 lb/acre-day, with higher values indicated should temperature of the pond water exceed his experimental limit of 95°F.

The third study examined was again a Ph.D dissertation, presented by W.R. King in 1973 to the North Carolina State University entitled: "Fluoride Emissions from Phosphoric Acid Gypsum Ponds". This report is also available as EPA 650-2-74-095, October 1974. Dr. King's studies included laboratory and field activities. The EPA report makes rather lengthy comments upon the King data and the following quotation from Section 4.4 probably sets it into perspective:

"It is important to note, first of all, that the velocity distribution in the wind tunnel is such that the velocity will approach zero at all four walls due to surface friction. As Tatera stated, there are no accepted hydrodynamic scaling parameters which allow wind tunnels results to be applied directly in large scale systems. The velocity profile above a pond generally follows a logarithmic distribution. It is zero at the surface and increases with height.

Nevertheless, in order to make a comparison of the two studies, a relationship, empirically developed by King, was used to scale Tatera's velocities to a height of 16 meters.

$$\frac{V_1}{V_2} = \frac{Z_1}{Z_2} \exp [0.2909 + 0.06154 (L) - 0.01164 (V_{16})] \quad 4.38$$

where:

V_1 = wind speed at Z_1 (0.1 meter)

V_2 = wind speed at Z_2 (16 meters)

L = measured lapse rate (between 2 and 16 meters)

V_{16} = wind speed at 16 meters

Comparisons of emission factors as determined by King and Tatera (incorporating the correction above) are presented in Table 4.4 for three temperatures. Comparisons at 75°F and 85°F are not readily applicable since most gypsum ponds operate at temperatures above 90°F. Typically, process waters enter the pond at 115°F and are returned to the process at 95°F. Unfortunately, Tatera obtained all of his data between 75°F and 95°F, while King conducted vapor pressure studies between

70°F and 100°F. It would have been far more useful to have obtained data between 85°F and 115°F.

Tatera's emission estimates at 95°F are approximately a factor of 2 greater than those of King. In accordance with our previous discussion, a judgement cannot be made as to the validity of either method of estimation when applied to a particular gypsum pond. It can be argued from purely physical chemical grounds that the emission rate should be about one-fifth the values determined by King*. Thus, the best statement that can be made at this point is that the characteristic emission factor appears to lie in the range of 0.1 to 10 lb/acre-day and that a careful field study would seem appropriate to determine the contribution of volatile fluorides from the ponds to the atmospheric fluoride levels around the ponds.

* Special communication with Dr. Alonzo Coots of International Consultants; based upon assumption of saturated calcium sulfate with calcium fluoride controlling free fluoride levels found in gypsum ponds. Attempts to verify these assumptions in the laboratory were confounded by the complexity of the solution.

Table 4.4 Comparison of Emission Factors Predicted by King and Tatera at Various Temperatures. [From EPA report Evaluation of Emissions and Control Techniques for Reducing Fluoride Emissions from Gypsum Ponds in the Phosphoric Acid Industry]

V ₁₆ M/Sec	EMISSION FACTOR IN LB/DAY-ACRE		
	1	2	4
V ₁ M/Sec	0.25	0.54	1.2
Ft/Min	50	106	238
<u>75°F</u>			
King (Pond 10)	0.96	1.6	2.9
Tatera (Process Water)	0.41	0.86	1.9
<u>85°F</u>			
King	0.75	1.3	2.2
Tatera	0.52	1.1	2.4
<u>95°F</u>			
King	0.92	1.6	2.8
Tatera	1.5	3.2	7.3
(EPA 1974)			"

A fourth study on fluoride emissions from ponds was made during August of 1977 by TRC - The Research Corporation of New England under EPA Contract No. 69-01-4145, Task 10. This EPA sponsored report was first published as a "Contractor's Preliminary Report" in November of 1977. The final report is still pending.

In this latest effort, strictly field work took place, using wet chemistry sampling methods and a new EPA-ROSE (Remote Optical Sensing of Emission) system which is based on absorption of infra red radiation. The preliminary conclusion (based upon wet chemistry only) of interest is quoted.

- "9. The fluoride emission rate from the gypsum pond has been calculated on the basis of the field runs employing vertical traverse. The emission rate was in the range of 4-10 lb/acre-day and the trend is that emissions increases with the wind speed increase." (EPA 1977a)

In summary, it would appear that all data tend to suggest fluoride emission factors of up to 10 lb. per acre per day. The parameters which govern the magnitude of this emission rate seem not to be fully understood. Whatever range of emissions rates are applicable for Occidental at the present time will in all probability remain applicable in the future.

The current pond area in use is on the order of 412 acres. Current emission data would therefore indicate the fluoride emission rate from existing ponds to be in the range of 40 to 4000 pounds per day.

2.2.2.3.2 Fluoride in the Environment -- Since fluoride emissions from ponds cannot be estimated with a reasonable degree of accuracy, and since emissions from ponds cannot be reasonably simulated with air quality models, the impact of existing fluoride emissions was determined by:

1. Measuring gaseous fluoride concentrations in the ambient air;
2. Measuring the fluoride concentrations in grass;
3. Observing the effects of fluorides on cattle; and
4. Observing the effects of fluorides on vegetation.

Airborne Fluorides

Gaseous fluorides in the ambient air have been measured at five monitoring sites (Figure 2.2-7), since November 27, 1977. The program is continuing.

Samples are collected at each monitoring site once every sixth day. The sample is collected by drawing ambient air through two Greenburg-Smith impingers in series. Each impinger contains 200 milliliters of 0.1 N sodium hydroxide solution. The sampling rate is approximately 0.5 cubic feet per minute. The samples are analyzed with a specific ion electrode.

The monitoring data through April, 1978 are summarized in Table 2.2-7. It will be noted that there is very little spatial variation in ambient fluoride levels. The average concentrations range from 0.7 to

1.0 micrograms per cubic meter. The average concentration for all sites is 0.8 micrograms per cubic meter. 24-hour concentrations range from 5.1 micrograms per cubic meter to 0.1 micrograms per cubic meter.

As a point of comparison the Florida Department of Environmental Regulation, in 1976, proposed the following ambient air quality standards for fluorides (FDER, 1976):

1. Annual - 0.71 micrograms per cubic meter;
2. For any 30-day period - 1.43 micrograms per cubic meter;
3. For any 24-hour period - 4.44 micrograms per cubic meter.

Fluoride in Grass

One potential economic impact of fluoride in the environment is the effect to livestock caused by ingestion of forage materials containing fluorides. In significant concentrations, the fluorides create a condition known as fluorosis. This manifests itself in mottling and/or softening of the teeth of livestock, and in alterations of bone structure.

The threshold concentration in forage material at which these effects become noticeable in beef and dairy heifers is 40 ppm of a soluble fluoride and 60 ppm of an insoluble fluoride. (National Academy of Sciences, 1974). For other species, higher dietary fluoride levels can be tolerated.

To determine the level of fluorides in potential forage materials near the Occidental site, ten sampling locations were selected. Eight of these represented potential pasture land, one site was on the dike of a cooling water pond and one site was located an intermediate distance from the cooling water pond. These sampling sites are shown in Figure 2.2-7. In addition to these sites a background site was selected in Gainesville, Florida.

Grass samples were collected at each of these sites monthly, beginning in December 1977. Approximately 200 to 300 grams of grass was collected at each site. In the laboratory each sample was placed in an ultrasonic cleaner with cold water for fifteen minutes. The purpose of this step was to remove particulate fluoride from the leaf of the grass prior to analysis. Both the washed grass sample and the wash water were analyzed for fluoride.

The fluoride levels in the grass samples collected during the period December 1977-June 1978 are presented in Table 2.2-7. It should be recognized that this period represents the time of year when grass fluoride levels are the highest. This is the result of little or no growth during the winter months and low rainfall during the spring months.

Monthly fluoride concentrations ranged from 5 to 88 ppm total fluoride in grass away from the existing chemical plant. The fraction of fluorides

contained in the grass (soluble) averaged 78 percent. The fraction contained on the surface of the leaf (insoluble) averaged 22 percent.

The grass from the monitoring site located on the dike of the cooling water pond exhibited an average fluoride concentration of 232 ppm with approximately 71 percent of the fluoride being contained in the leaf of the grass. Grass a moderate distance (800 meters) from a cooling water pond had an average fluoride concentration of 71 ppm with approximately 67 percent of the fluoride being contained in the grass leaf. Fluoride concentrations in grass samples collected in Gainesville, Florida during this period averaged 19 ppm.

Observed Effects of Fluorides on Livestock

Cattle from three sites were examined in April 1978 by a veterinarian experienced in the effects of fluorosis (Crum, 1978). The study was made to determine if cattle born and raised near the Occidental site are affected by fluorides in the forage provided them.

The area is utilized primarily for pulpwood production. There are, however, a number of small farms and pasturelands located within a 5-mile radius of the plant. The three sites investigated are shown on Figure 2.2-7.

All cattle examined were raised in the area where they were examined. They had free access to pasture grasses year-round and in some cases received locally grown hay and corn as a winter feed supplement.

The cattle were examined to determine if individual animals had consumed excessive fluorides during their early dentition periods (first five years of age) as evidenced by changes in the structure and wear of teeth. Twenty-one animals, ranging in age from 10 months to 13 years, were examined. Eight animals were examined at the south and east sites and five were examined at the southwest site.

The examination showed the greatest effect to be that defined:

Slight Effect - slight mottling of enamel, best observed as horizontal striations with transmitted light; may have slight staining but no increase in normal rate of wear (National Academy of Sciences, 1974).

This effect was exhibited in a total of nine teeth from six of the 21 animals examined. The number of teeth showing effects in these six animals ranged from one to three.

The examination further revealed the cattle to be free from skeletal fluorosis. It was concluded that none of the effects were sufficient to cause a loss of productivity.

Effects of Fluorides on Vegetation

Surveys conducted in the area since 1974 have revealed no significant fluoride effects on vegetation anywhere in the area. The latest survey

was conducted in March 1978. The only effects noted at that time were moderate tip necrosis on a few pine trees located on the dike forming one of the cooling water ponds. Maple, sweet gum, willow and other shrubby material on the dikes showed no fluoride effects. Pine trees, a few hundred meters from the ponds, were normal (Brandt, 1978).

Observations in the vicinity of the Swift Creek site revealed no fluoride effects.

2.2.2.4 Existing Carbon Monoxide, Nitrogen Oxides and Hydrocarbon Burden

The 1977-78 CO, NOx and hydrocarbon burden in Hamilton County is very small. Because of the small existing burden and the correspondingly small impact on air quality, only the burden of each of these pollutants has been estimated using EPA emission factors (EPA, 1976).

The sources considered were automotive, space heating, and fuel combustion at the Occidental complex. The burden of each of these pollutants for the 1977-78 period is presented in Table 2.2-8.

2.2.3 NOISE STUDY

2.2.3.1 Noise Surveys

Noise level measurements were conducted on three separate dates to establish baseline noise levels for the proposed site and environs and to determine noise emission and propagation characteristics from a similar chemical plant. The dates of acoustic data acquisition were November 18, 1977, December 20, 1977 and December 27, 1977. Meteorological conditions on each of the survey dates were typical for the site - temperatures (Min.-Max.), 45°F-75°F, 40°F-70°F, 34°F-65°F; light wind, less than five mph; clear skies. Instrumentation included a B&K Type 2203 Precision Sound Level Meter, a B&K Type 1613 Octave Band Filter Set, B&K Type 4230 Acoustic Calibrator and a B&K Type UA 0207 Windscreen. The windscreen was attached to the microphone (B&K Type 4145) during all measurements and a battery and calibration check was performed (successfully) before and after each period of measurement.

The proposed Swift Creek Chemical Complex is located adjacent (North) to the processing plant for the existing Swift Creek mine. The mine was not in operation during the noise survey period but will resume operation after the chemical complex is completed. The Suwannee River mine and Chemical complex is in operation (Occidental Chemical Company) and is located about four miles west of the Swift Creek mine. Figures 2.2-8 and 2.2-9 indicate the positions of noise monitoring stations for the surveys at the proposed sites, the existing mine and chemical plant and around the periphery of the region of the sites.

Noise survey data from the proposed site and from outlying areas indicated little temporal or spatial variation. Roadway traffic volume in this sparsely populated north Florida region is low and generally contributes little to average noise levels (L_{50}). Railway and aircraft noise effects are inconsequential. The sound field is characterized by nature sounds: crickets, birds and the effects of wind in trees, bushes and brush. The data are indicative of a "rural/wilderness" area with an average daytime L_{50} value of 35 dBA. An overall, single number rating for the proposed site is thus estimated as $L_{eq} = L_{dn} \leq 40$ dB. (see U.S. EPA Report 550/9-74-004, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", March 1974.)

Measurements of noise levels at the operating Suwannee River mine site and the adjacent chemical complex clearly establish the principal noise sources to be associated with fluid handling equipment: motors, turbines, blowers and pumps. Data were recorded at eight stations around a phosphoric acid plant. Noise levels were constant at each station and varied from 81 dBA at the corners (50 feet distance) to 89 dBA at the sides. However, it appears that if levels were measured at equal distances from the center of the plant (this was not possible at the existing site), all levels would be roughly the same. Hence little

directionality of noise emission from phosphoric acid and similarly from superphosphoric acid plants is indicated.

Octave Band sound levels were measured near a large air blower and near a row of pumps for the phosphoric acid plant. For the two cases, the band level at 1 KHZ was nearly the same. The spectrum for the pumps was nearly flat below 1 KHZ but increased out to 4 KHZ before it rolled off. The fan spectrum generally decreased with increasing frequency. No significant pure tones were detected.

Directionality of noise emission from an operating sulfuric acid plant was pronounced. Levels at different monitoring stations ranged from a maximum of 95 dBA near a turbine driven blower to 80 dBA at the opposite end of the plant near the cooling tower (50 feet distance). Octave Band measurements near the blower showed a broadband, flat spectrum out to 8 KHZ. Plant personnel are generally not in the vicinity of this blower but a warning sign, "High Noise Area", is posted to alert maintenance personnel to use personal hearing protection.

Data on propagation of noise from the chemical complex over the mine area were obtained. Noise level attenuation with distance from the source occurred almost precisely according to the relation of 6 dB per doubling of distance (spherical point source equation). Excess attenuation associated with relaxation (microscopic) phenomena, topology and (partial) ground cover was apparently closely compensated by earth-moving equipment operating at various locations over the mine site.

Attenuation of noise levels to ambient baseline levels required a distance of one to one-and-a-half miles from the boundary of the chemical plant.

Noise levels near the ore processing plant (flotation plant-approximately one mile from the chemical complex) were found to be constant at 82 dBA (distance of 50 feet). Propagation of noise with distance was again found to follow the 6 dB per doubling of distance relation as found for the chemical complex noise and for the same reason.

In summary, the noise surveys established the following:

1. The proposed plant site as presently exists (non-operating) is a very quiet region. An $L_{dn} \leq 40$ dB was determined for the site and this value is typical of adjacent outlying areas.
2. Levels, spectra and directionality of noise sources similar to those proposed for the Swift Creek plant were determined.
3. Noise propagation characteristics were determined.
4. There are no residents within one-and-a-half miles of the proposed site.

Table 2.2-1. Particulate Matter Emission Data for Existing Sources (1978) for Occidental Chemical Company, White Springs, Florida

Source	Emission Rate		Stack Data				Source Location	
	Annual (tons/yr)	Maximum (gr/sec)	Height (m)	Temp. (°K)	Velocity (m/sec)	Dia. (m)	X Cord. (km)	Y Cord. (km)
Sulfuric Acid A	0.230	2.63	61.0	350.0	15.5	1.83	28.64	69.00
Sulfuric Acid B	0.230	2.63	61.0	350.0	15.5	1.83	28.64	69.04
Sulfuric Acid C	0.120	1.42	45.7	356.0	27.9	1.58	28.66	69.15
Sulfuric Acid D	0.120	1.42	45.7	356.0	27.9	1.58	28.66	69.20
DAP 1	0.042	0.50	36.6	322.0	12.2	2.13	28.43	68.90
DAP 2	0.108	1.20	42.7	325.0	13.1	2.44	28.40	68.90
DAP Shipping	0.004	0.15	36.6	310.0	15.7	0.17	28.50	68.75
Phos. Acid A	0.046	0.50	30.5	310.0	11.4	1.07	28.70	68.85
Phos. Acid B	0.002	0.03	32.0	311.0	16.2	1.22	28.70	68.92
Phos. Acid C	0.002	0.03	32.3	310.0	9.5	1.22	28.70	68.90
Phos. Acid B & C Bag House	0.001	0.01	29.3	311.0	9.1	0.24	28.75	68.85
TSP	0.026	0.30	30.5	325.0	13.7	2.13	28.43	69.02
TSP Shipping	0.110	4.50	30.5	310.0	14.5	1.98	28.50	69.00

Table 2.2-1--Continued

Source	Emission Rate		Stack Data			Source Location		
	Annual (tons/yr)	Maximum (gr/sec)	Height (m)	Temp. (°K)	Velocity (m/sec)	Dia. (m)	X Cord. (km)	Y Cord. (km)
TSP Storage	0.027	0.3	36.6	316.0	13.1	2.44	28.45	69.05
Aux Boiler (A and B Sulfuric)	0.012	0.48	12.2	451.0	7.7	1.13	28.60	69.01
Aux Boiler (C and D Sulfuric)	0.060	2.48	10.7	468.0	9.5	1.46	28.61	69.17
Polyphos	0.190	2.20	30.6	314.0	32.7	0.91	28.73	68.76
SPA	0.000	0.01	30.5	318.0	19.0	0.46	28.58	68.83
Rock Grinder (Hardinge)	0.035	0.40	39.6	345.0	5.8	0.71	28.70	68.75
Rock Grinder (KVS)	0.380	4.40	36.6	339.0	8.2	1.07	28.75	68.75
Rock Dryer (SCCC)	0.280	5.70	15.2	317.0	17.2	2.13	20.95	63.95
Minerals Silo (SCCC)	0.008	0.18	33.5	310.0	6.2	1.52	21.00	68.95
Minerals Rock Grinder	0.020	0.20	18.3	310.0	10.8	0.91	30.20	68.40
Minerals Silo	0.008	0.18	33.5	310.0	6.2	1.52	30.15	68.40
Rock Dryer East	0.056	1.20	18.3	343.0	8.3	3.05	30.12	68.45
Rock Dryer West	0.079	1.7	18.3	343.0	10.2	3.05	30.10	68.45

Table 2.2-2. Sulfur Dioxide Emission Data for Existing Sources (1978) for Occidental Chemical Company, White Springs, Florida

Source	Emission Rate			Stack Data			Source Location	
	Annual (tons/yr)	Maximum (gr/sec)	Height (m)	Temp. (°K)	Velocity (m/sec)	Dia. (m)	X Cord. (km)	Y Cord. (km)
Sulfuric Acid A	13.100	152.25	61.0	350.0	15.5	1.83	28.64	69.00
Sulfuric Acid B	13.100	152.25	61.0	350.0	15.5	1.83	28.64	69.04
Sulfuric Acid C	3.240	37.90	45.7	356.0	27.9	1.58	28.66	69.15
Sulfuric Acid D	3.240	37.90	45.7	356.0	27.9	1.58	28.66	69.20
DAP 1	0.063	0.74	36.6	322.0	12.2	2.13	28.43	68.90
DAP 2	0.107	1.25	42.7	325.0	13.1	2.44	28.40	68.90
TSP	0.063	0.74	30.5	325.0	13.7	2.13	28.43	69.02
Aux Boiler (A and B Sulfuric)	0.060	0.63	12.2	451.0	7.7	1.13	28.60	69.01
Aux Boiler (C and D Sulfuric)	0.310	3.23	10.7	468.0	9.5	1.46	28.61	69.17
Polyphos	0.500	5.66	30.6	314.0	32.7	0.91	28.73	68.76
SPA	0.452	5.25	30.5	318.0	19.0	0.46	28.58	68.83
Rock Dryer (SCCC)	0.110	2.39	15.2	317.0	17.2	2.13	20.95	68.95
Rock Dryer East	0.221	2.58	18.3	343.0	8.3	3.05	30.12	68.45
Rock Dryer West	0.221	2.58	18.3	343.0	10.2	3.05	30.10	68.45

Table 2.2-3 Summary of Air Quality Modeling for 1977-78 SO₂ Levels, Occidental Chemical Company

Averaging Time	FDER Air Quality Standard	Maximum Calculated SO ₂ Concentration (µg/m ³)		
		Occidental SCCC ^a	Occidental SRCC ^a	Okefenokee ^b (Class I) 1977-78
Annual	60	7	20	1
24-Hour	260	105	254	7
3-Hour	1,300	35	1214	64

^aSCCC = Swift Creek Chemical Complex and SRCC = Suwannee River Chemical Complex.

^bSholtes & Koogler Environmental Consultants, November 1977.

Table 2.2-4 Summary of Measured Ambient SO₂ Levels-Occidental
Chemical Company-Hamilton County, Florida
May 1977-January 1978

	Site Number ⁽¹⁾			
	3	4	7	Lime Station
Number of 24-Hour Periods	196	252.5	210.5	248.5
Arithmetic Mean (ug/m ³)	1.0	3.1	17.0 ⁽³⁾	2.0
Highest Measured ⁽²⁾ 24-Hour Conc. (ug/m ³)	35	149	197	34
2nd Highest ⁽²⁾ Measured 24-Hour Conc. (ug/m ³)	16	56	85	32

(1) See Figure 2.2-4

(2) Measured during normal plant operations

(3) Includes periods of plant upset

Table 2.2-5 Summary of Air Quality Modeling for 1977-78 Total Suspended Particulate Matter Levels, Occidental Chemical Company, Hamilton County, Florida

Averaging Time	FDER Air Quality Standards	Maximum Calculated TSP Concentration ($\mu\text{h}/\text{m}^3$)	
		Occidental SCCC(1)	Occidental SRCC(1)
Annual (2)	60	33	34
24-Hours (3)	150	77	116

(1) SCCC = Swift Creek Chemical Complex; SRCC = Suwannee River Chemical Complex

(2) Includes background of 31 micrograms per cubic meter

(3) Includes background of 61 micrograms per cubic meter

Table 2.2-6 Summary of Total Suspended Particulate Matter Monitoring Data -- Occidental Chemical Company, Hamilton County, Florida -- October 1975-October 1977

	(1) Site Number					
	(3) 1	(3) 2	4	5	6	7
Number of Samples	47	100	91	97	28	93
Geometric Mean Conc. ($\mu\text{g}/\text{m}^3$)	25	31	43	38	41	37
Expected Second High Conc. (2) ($\mu\text{g}/\text{m}^3$)	69	81	148	96	(4)	140
95th Percentile Conc. ($\mu\text{g}/\text{m}^3$)	48	58	100	82	(4)	73

(1) See Figure 2.2-4

(2) As determined by method of Larson (1971) "A Mathematical Model for Relating Air Quality Measurements to Air Quality Standards", AP-89, U.S. EPA, Office of Air Programs, Research Triangle Park, N.C., November 1971.

(3) Sites discontinued in May, 1977

(4) Sample size too small

Table 2.2-7 Summary of Ambient Air and Grass Fluoride Concentration Data for November 1977 - June 1978, Occidental Chemical Company, Hamilton County, Florida

Site (1)	Fluoride Concentration									
	Ambient Air ($\mu\text{g}/\text{m}^3$)				Grass (mg/kg)					
	Number 24-hr Samples	Max.	Min.	Avg.	Number Monthly Samples	Soluble (2)	Insoluble (3)	Total	Max. Total	Min. Total
Air Grass										
A 10	24	5.1	0.1	1.0	7	34.3	8.7	43.0	81.9	8.3
B 9	24	4.3	0.1	0.8	7	33.4	6.2	39.6	69.3	7.6
C 8	24	3.1	0.2	0.8	7	35.9	10.5	46.4	88.1	10.9
D 5	21	3.1	0.1	0.7	7	28.4	8.7	37.1	52.9	13.4
E 4	22	2.5	0.3	0.9	5	17.6	9.3	26.9	50.1	6.1
1					7	20.6	4.4	25.0	55.8	5.2
2					7	32.3	7.5	39.8	81.4	11.6
3					7	32.1	5.8	37.9	72.2	9.7
6					7	229.0	94.0	323.0	474.0	205.0
7					7	47.3	23.3	70.6	137.4	30.6
Background					5	16.3	2.3	18.6	36.1	6.7

- (1) See Figure 2.2-7
 (2) Soluble Fluoride is defined as that remaining in leaf after washing for 15 min. in ultra-sonic cold water bath.
 (3) Insoluble Fluoride is defined as that washed from leaf surface.

Table 2.2-8 1977-78 County-wide Carbon Monoxide, Hydrocarbon,
and Nitrogen Oxide Burden for Hamilton County,
Florida

Source	Pollutant (tons/year)		
	CO	Hydrocarbons	NO _x
Automotive	5001	635	873
Space Heating	1	0	6
Point Sources	<u>53</u>	<u>11</u>	<u>640</u>
Total	5055	646	1519

Note: These estimates based upon EPA document "Compilation of
Air Pollutant Emission Factors", Feb. 1976.

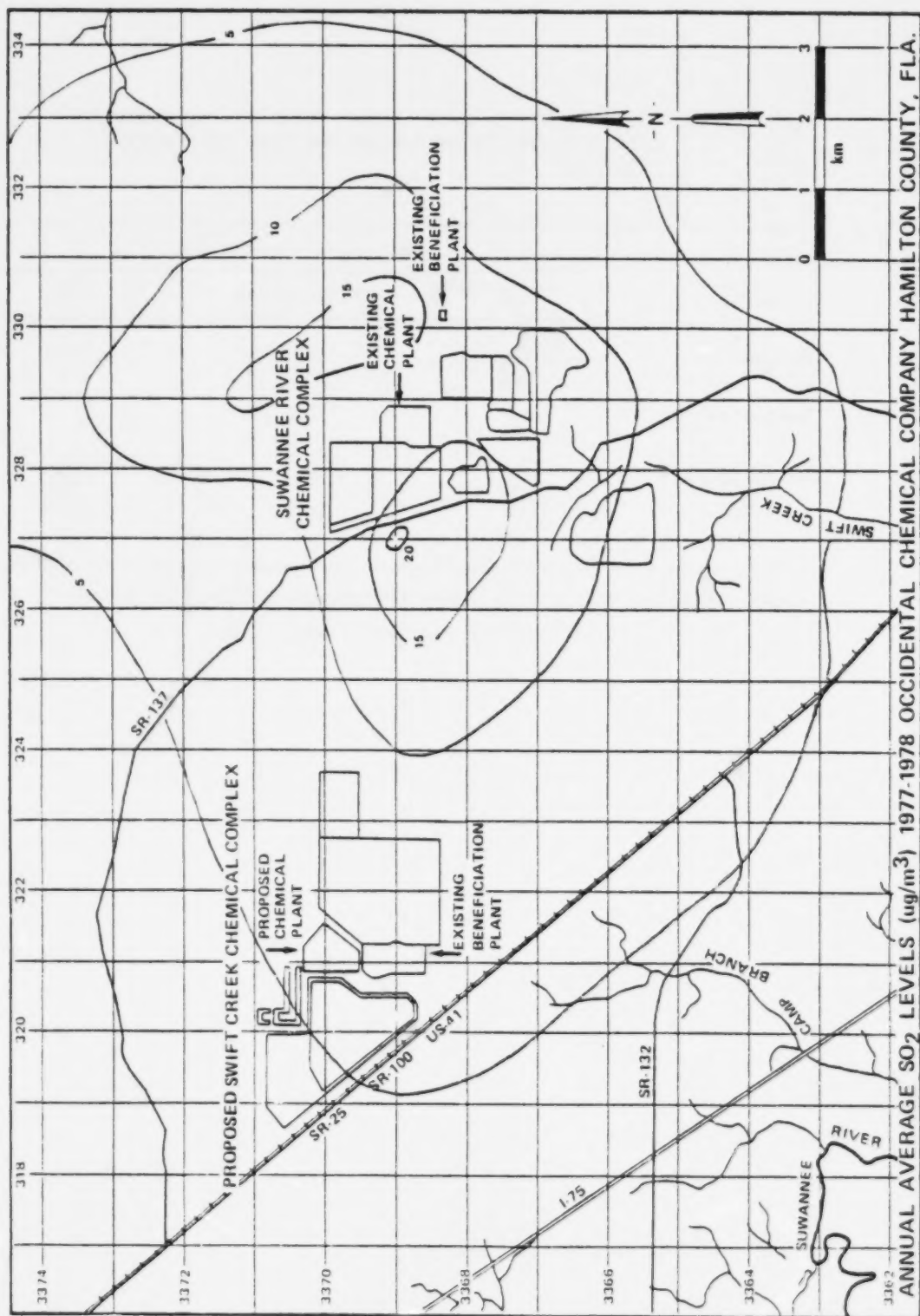


FIGURE 2.2-1

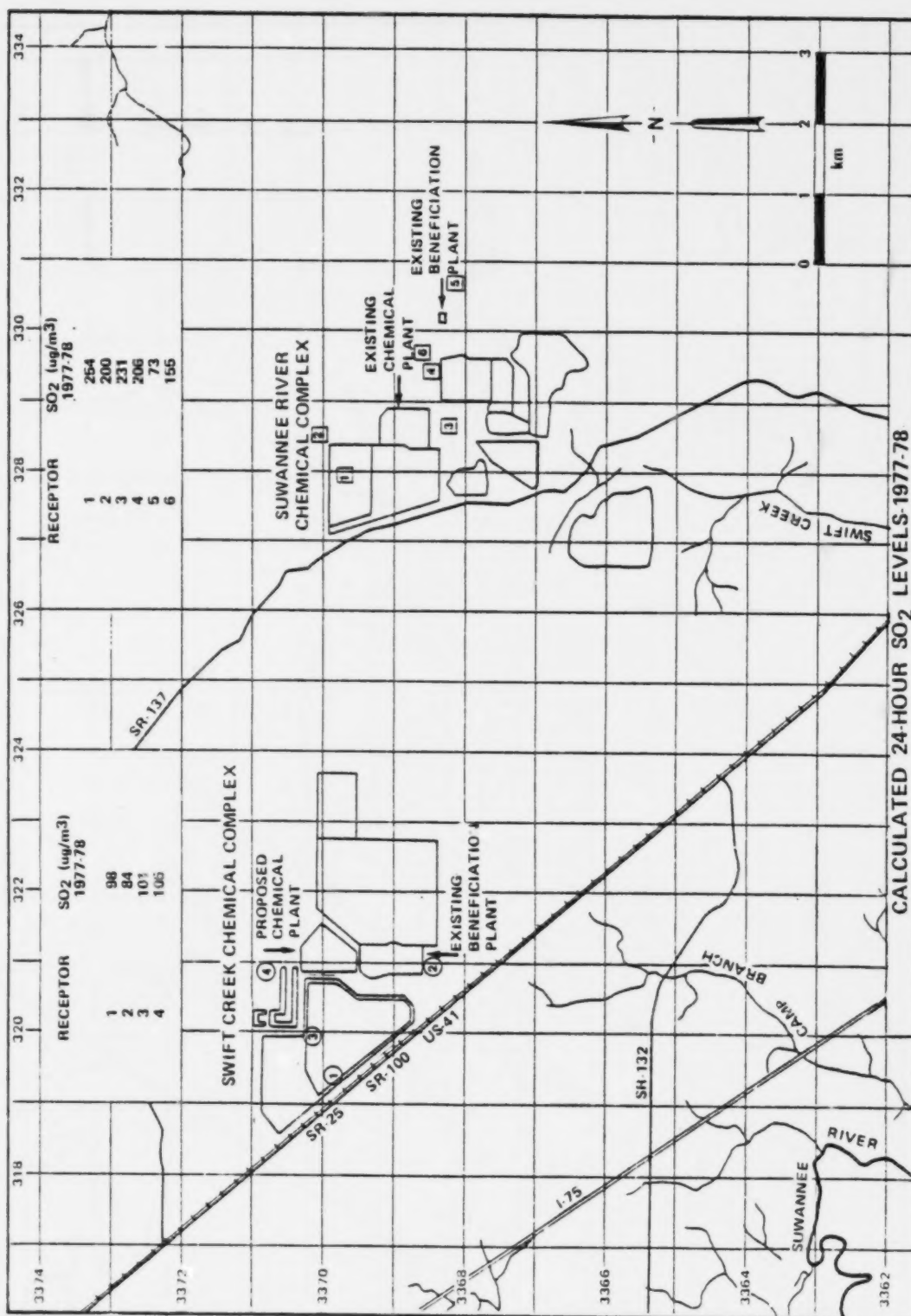


FIGURE 2.2-2

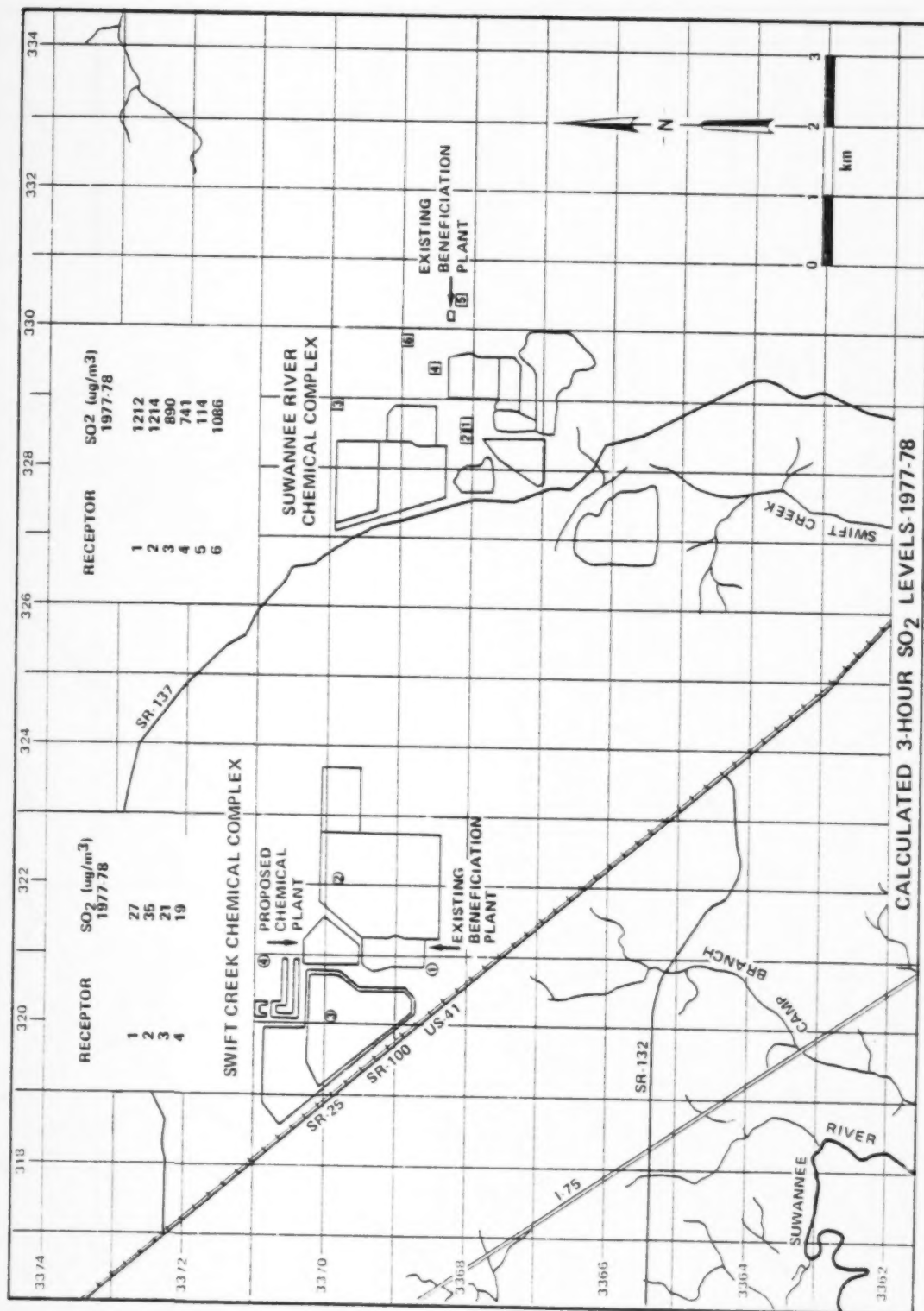


FIGURE 2.2-3

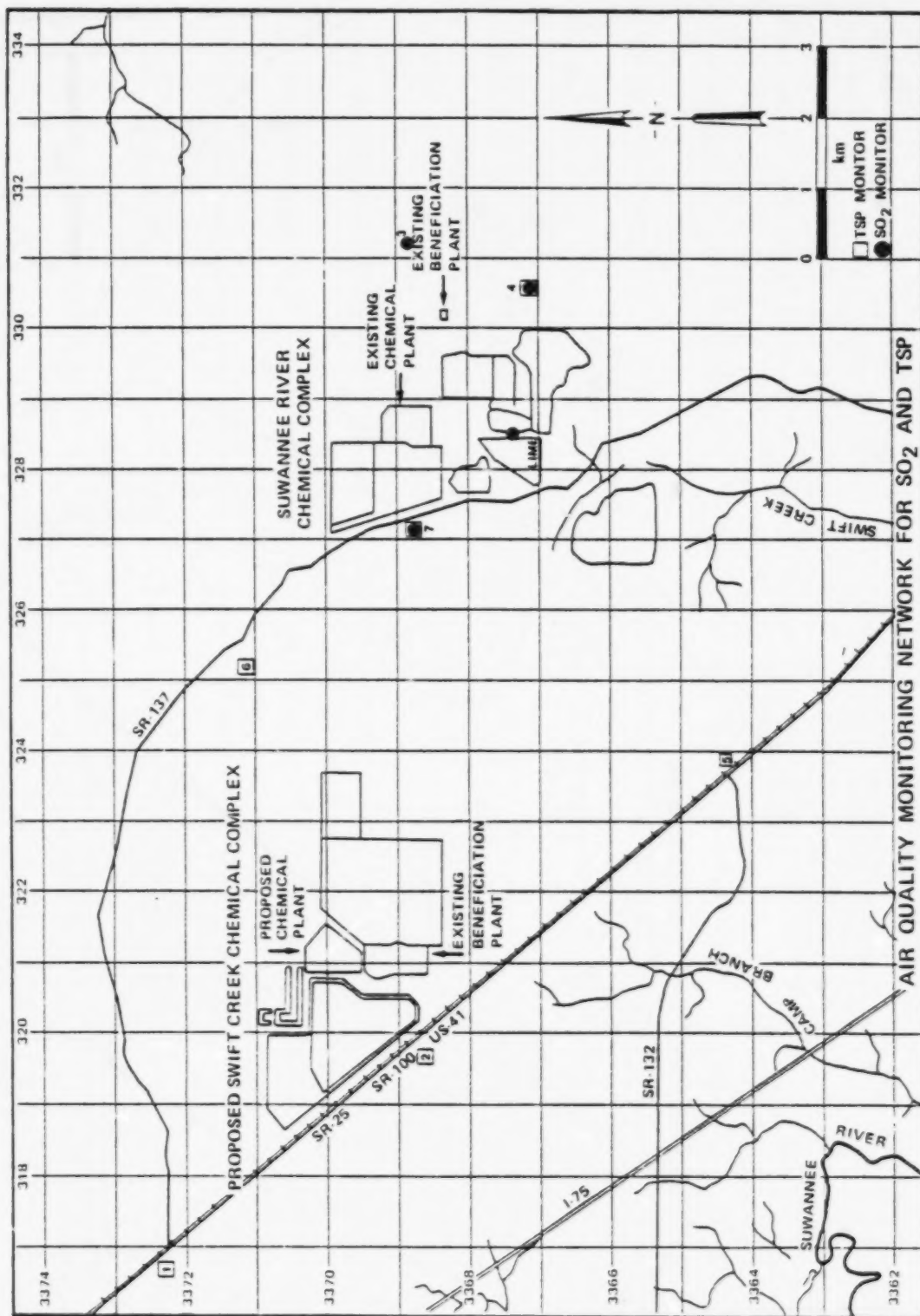


FIGURE 2.2-4

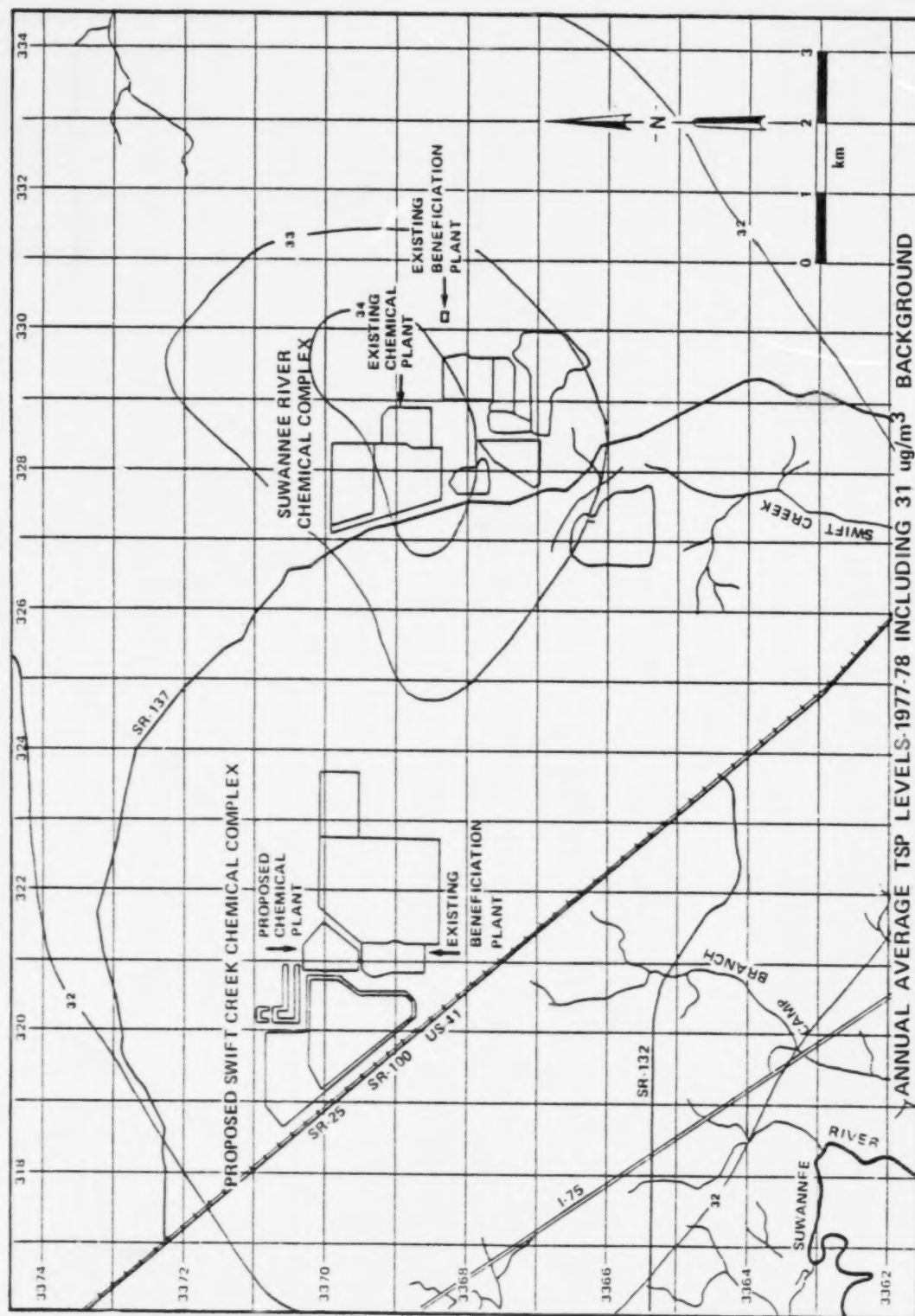
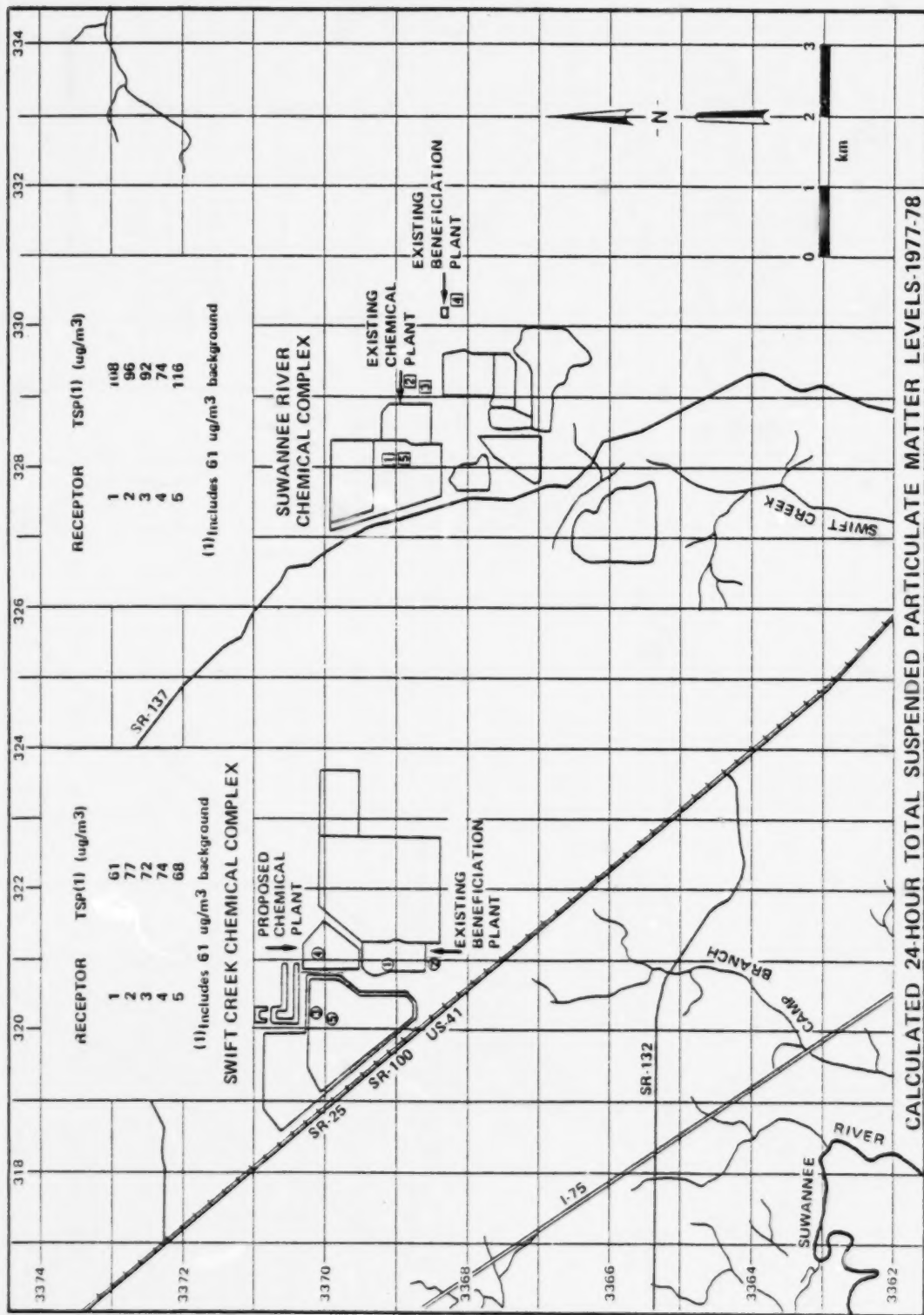


FIGURE 2.2-5



CALCULATED 24-HOUR TOTAL SUSPENDED PARTICULATE MATTER LEVELS-1977-78

FIGURE 2.2-6
2-72

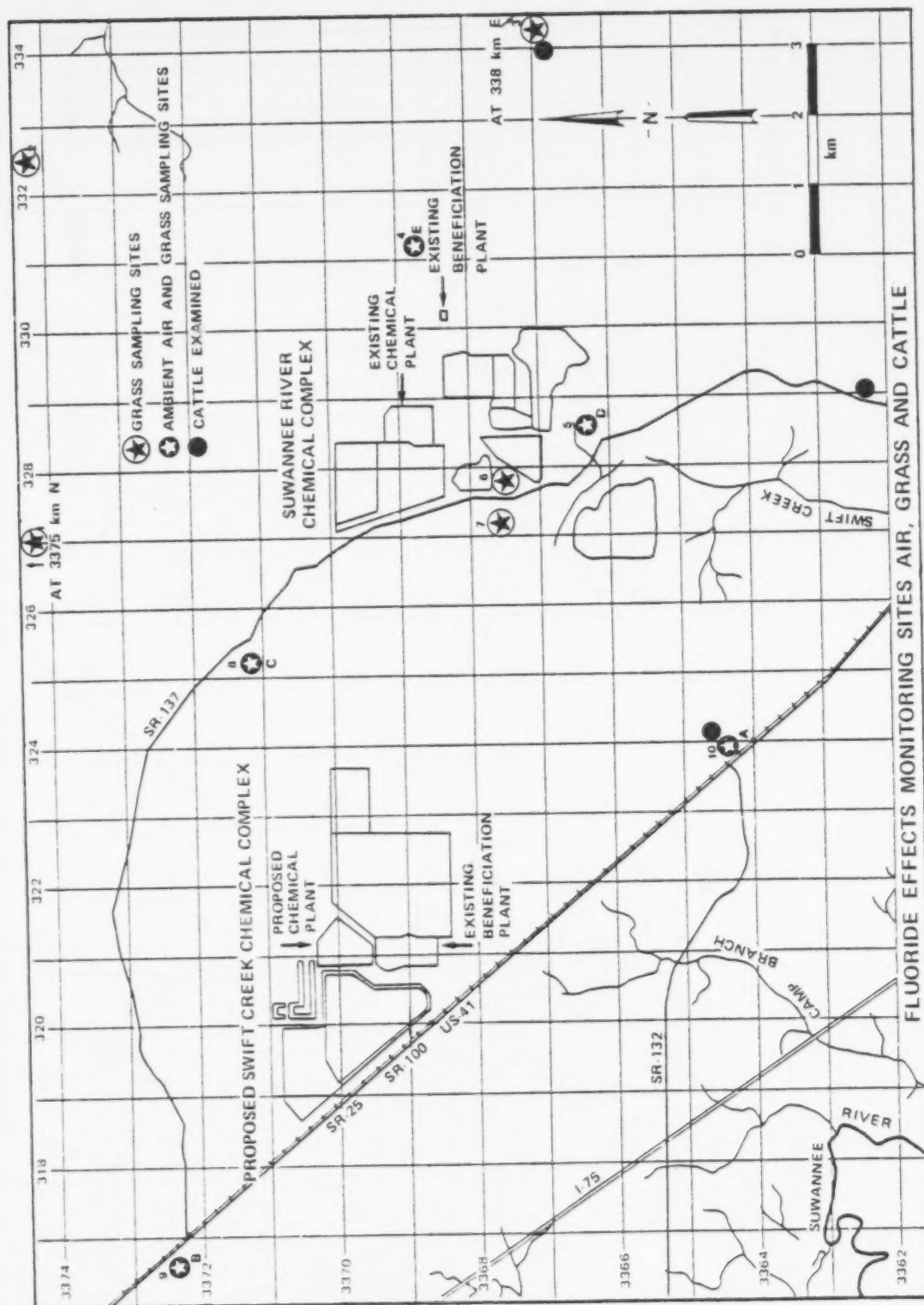
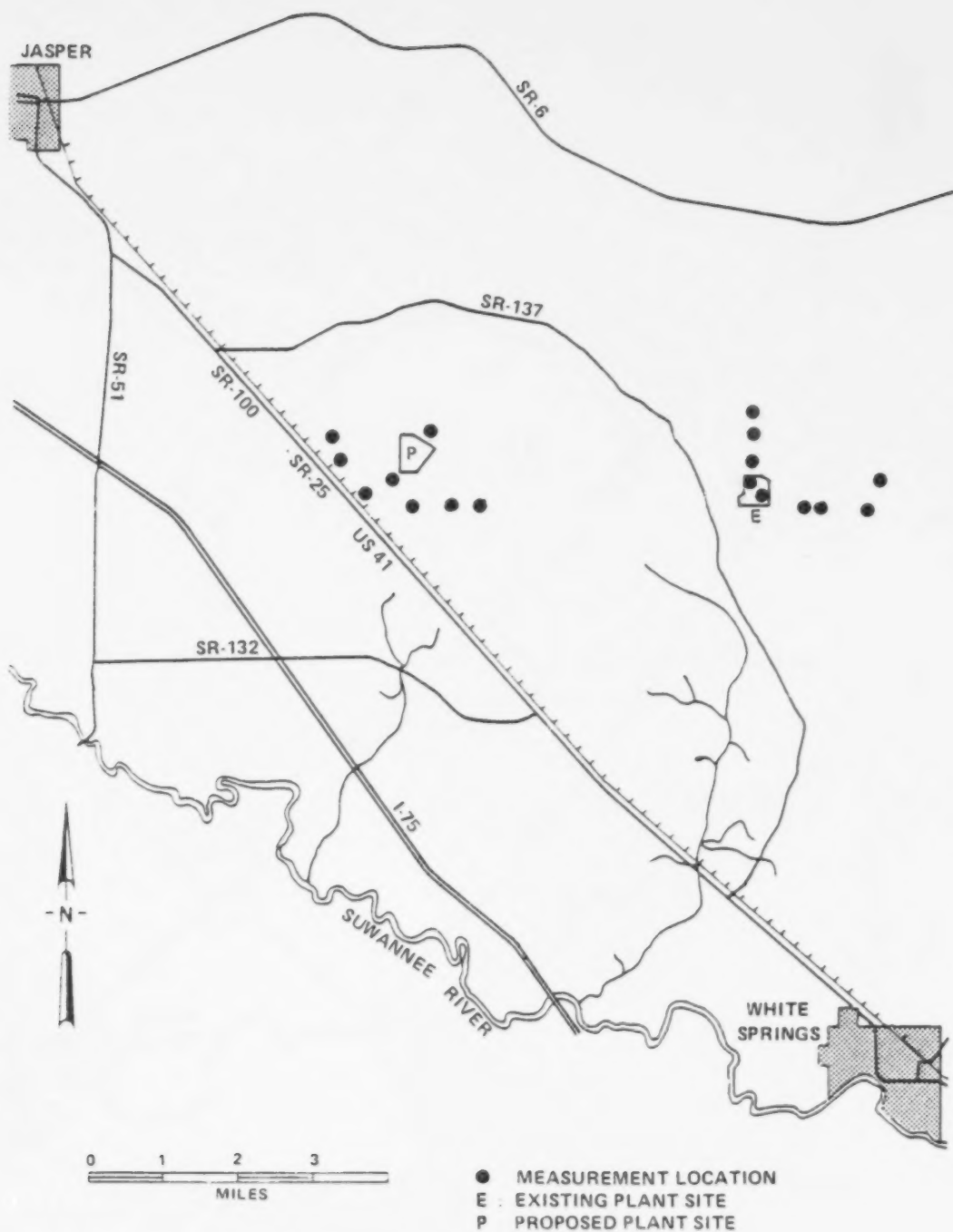


FIGURE 2.2-7



NOISE MEASUREMENT LOCATIONS OFF-SITE

FIGURE 2.2-8



NOISE MEASUREMENT LOCATIONS ON -SITE

FIGURE 2.2-9

APPENDIX A
(Section 2.2)

FIELD SURVEYS FOR FLUORIDE EFFECTS ON CATTLE AND VEGETATION

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WHITE SPRINGS, FLORIDA

Dr. Brandt
SURVEY

November 15 and 16, 1977

12-12-77

I surveyed the area around the White Springs, Florida, plant of Occidental Chemical Company for possible effects of air pollutants on the surrounding vegetation as a result of plant operations. I also examined the area around the Swift Creek Mine area to identify any potential impact from the proposed super phosphoric acid operations at that site. Mr. John Wester, of Occidental Chemical Company, accompanied me.

None of the vegetation exhibited any symptoms suggestive of chronic sulfur dioxide injury. At the time of my visit normal senescence had obscured any chronic symptoms on much of the deciduous vegetation. However, the remaining deciduous material and the pine appeared normal for the season and site.

An area along SR 137 showed evidence of a moderately severe burn from sulfur dioxide, possibly in combination with sulfuric acid mist. The affected area starts at the road, a mile due east of the chemical plant complex and extends irregularly west of the road for roughly 0.4 miles and for approximately 1.2 miles in a north-south direction along the road. The major injury occurred in an irregularly shaped plantation of slash pine about eight years old. The date of the episode is unknown. The symptoms were apparently fully developed when first noted in the middle of the summer. At the time of my visit, secondary infections and other normal changes have confounded the injury patterns. There are some suggestions of more than one episode but the patterns are not definitive. On some trees, there are stunted needles presumably on late secondary or adventitious candles. This may be the result of an insect or a pathogen or, maybe, an "acid rain" response. The only symptoms seen on species other than pine was a pattern suggesting sulfur dioxide on some oak (probably blackjack).

The effects of this single burn on the final yield of the plantation probably will not be measurable. Repeated episodes could result in measurable reductions in yield. However, such episodes do have a visual impact that can have a significant, adverse effect upon the public image of the Company.

One young pine on the southwest corner of the dike forming the cooling pond shows typical fluoride injury. Several small pines along the west side of the dike showed some symptoms that are probably fluoride injury.

DEC 14 1977

M. JOVE

White Springs, Fla., Survey
November 15 & 16, 1977

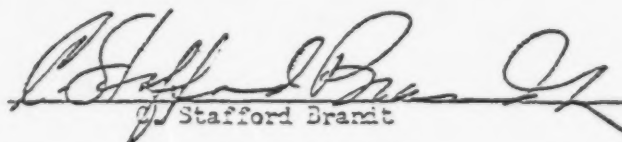
The area is not readily accessible so that I was unable to examine the needles closely enough for confirmation. These are the only suggestions of effects from fluoride that I found in the area.

The types of vegetation and their distribution around the Swift Creek Mine area proposed for expansion are similar to those around the present operations. The effects from chronic sulfur dioxide exposure should be of no significance to the productivity of the area, assuming applicable emission and ambient air standards are met. The effect of fluorides should be as negligible as at present. Detectable symptoms may occasionally develop on sensitive material in the immediate vicinity of sources of gaseous fluorides.

Acute type injury on vegetation from sulfur dioxide, "acid mist", or both is an ever present hazard around sulfuric acid plants. Under steady operating conditions at either location, the probability of injury is very low. However, during start up and various temporary upsets or shifts in operations, emissions may be much greater than during steady operating conditions. These increased emissions increase the probability of injury. With the proper combination of meteorological conditions, duration of the excess emissions, time of year and a host of other environmental factors, a burn such as experienced along SR 137 is inevitable. Insofar as possible, changes in operations that increase emissions should be avoided during weather conditions favoring looping or coning plumes, sharp local inversions and prolonged stagnations.

Since farm crops are not an important use of the immediate area around the existing plant or the proposed expansion area, the economic impact of a single burn such as was experienced this year is low. However, more severe burns or the accumulative effect of repeated burns on the same area over several years can result in significant reduction in yield of the forest crop. I should point out that had the area along SR 137 been planted to a field crop such as corn, a significant crop loss would have occurred. Although a single moderate burn in a forest plantation may not result in any significant economic loss to the plantation, if it is highly visible to the public there will be an adverse effect on the Company image. From this standpoint, the area along SR 137 is especially vulnerable. A similar area along US 41 will be subject to a potentially greater impact from the proposed new installation.

As a matter of good public relations as well as protection against excessive claims, any burn suspected as a result of company operations should be investigated and documented as soon as detected. The limits of the affected area should be marked. General color photographs, as well as detailed closeup photographs of the various symptoms seen on all types of vegetation in the area, should be taken. Follow up surveys should be made at approximately weekly intervals, as needed, to document any changes in the symptoms or the extent of injury. Had this been done for this last burn, company staff might have been able to determine the specific meteorological and operating conditions that existed at the time, resulting in the injury. If I had had photographs of the early injury and subsequent development, I would have been able to provide a better statement of cause and a clearer evaluation of the other patterns now present. If a claim for damages had been made, such documentation would have been indispensable in limiting liability.


J. Stafford Brandt

FIELD SURVEY

OCCIDENTAL CHEMICAL CO., White Springs, Fla.

March 28-29, 1978.

At the request of Sholtes and Koogler, Environmental Consultants, Gainesville, Fla., I examined the area around installations of Occidental Chemical Co., at White Springs, Fla., for possible injury to vegetation from air pollution.

For this visit, I followed the procedures used on previous visits over the past four years:

1. Examined various areas of pine plantations, hedge row deciduous material and any agricultural crops 10 to 20 miles from the plant site for background information on stage of growth, frequency of common diseases and general condition.
2. Tour the immediate area of the plant and surrounding mining areas with John Wester, of Occidental Chemical. Roads are usually available to give good coverage of the area out to 4-5 miles from the center of the site.
3. Using available county and other roads, tour the remaining area out to 8 to 10 miles from the center of the site.
4. Visit with other knowledgeable observers of the area, if appropriate.

On this visit, I talked with:

- a. Mr. Rance Andrews. Agricultural County Agent for Hamilton County, Fla.
- b. Mr. Eugene Schreiber, Forester, Owens Illinois.
- c. Mr. Charles Parrish, Forester, Continental Can Co.

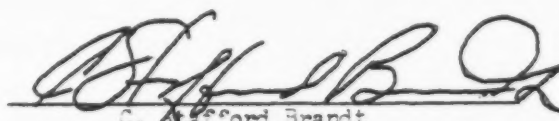
The general appearance of the area is good. The pine are candling out well and are of good color. They show no clear evidence of any effects from the drought. As with previous surveys, I found no significant evidence of fluoride injury. A few pine on and beside the south and west dike forming the Number 1 cooling pond show a moderate degree of tip necrosis characteristic of fluoride accumulation. The observation is expected, considering the location. Maple, sweet gum, willow and other shrubby material along the dike do not show characteristic symptoms of fluoride injury. The nearest other pine, a few hundred yards away from the pond, appear normal.

Sometime last summer, possibly in July, an area of young pine along county route 137, due west of the chemical plant complex, were affected by something. I did not see the area until November. At that time,

secondary infections and age had modified the symptoms. A short time exposure to a high concentration of SO_2 , possibly with some acid mist, seems to be the most logical explanation. At that time the deciduous material was too old for any good confirmation. However, I could find no suggestions of fluoride injury. On this present trip the old injury is still evident but the trees are camiling normally and damage, if any, will be slight. All deciduous material appears normal. Other than this one area, I have found no evidence of effects on vegetation from sulfur oxides.

Mr. Andrews had not seen or received any reports of possible air pollution effects on any agricultural crops during the past season. Since the pine along county route 137 belong to Owens Illinois, Mr. Schreiber had examined that area. He had not seen any other possible air pollution effects. Mr. Parrish had seen the effects along route 137 but no other effects on any of the pine in the area. Neither forester could give an accurate date of when he first saw the effect.

The area around the proposed expansion at the Swift Creek mine site is very similar to the present site. Fluorides should pose no more of a problem than at present. The major problem will probably be from sulfur oxides resulting from atypical operations during periods of atypical meteorology.



C. Stafford Brandt

CATTLE STUDY
HAMILTON COUNTY, FLORIDA
John B. Crum, D.V.M.

APRIL 1978

CATTLE STUDY - HAMILTON COUNTY, FLORIDA

This study is made for the purpose of determining if cattle born and raised near the phosphate mining and processing operations of Occidental Petroleum Company in North Florida are affected by air borne Fluorides that may or may not concentrate in the forage provided them.

The study occurred in an area utilized primarily for the growing of pine trees. There are, however, a number of small farms and pasturelands located within a five mile radius of the plant. Owners of cattle located at varying distances and directions from the plant site were cooperative in offering and presenting their cattle for examination.

All cattle were raised on the premises on which they were examined unless otherwise noted. They had free access to pasture grasses year around and in some cases received locally grown hay and corn as a winter feed supplement.

No attempt was made to determine the possibility of Fluoride accumulation from drinking water sources, from pasture fertilization or mineral supplementation. It is doubtful in the opinion of the author that any of these sources have measurably contributed to concentrations that may exist.

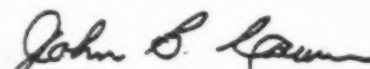
An effort has been made to determine if individual animals had consumed excessive Fluorides during their early dentition periods (first five years of age) as evidenced by changes in the structure and wear of teeth. A classification for describing changes as they have occurred in other studies throughout the country, and for the purpose of these evaluations is as follows:

0. Normal: smooth, translucent, glossy white enamel; tooth normal shovel shape.
1. Questionable effect: change discernible, exact cause not determined; may have enamel flecks: cavities if present may be unilateral or bilateral but with the absence of mottling.
2. Slight effect: slight mottling of enamel; may have slight staining but no wear; teeth normal shovel shape.
3. Moderate effect: definite mottling and staining of enamel; coarse mottling (large patches of chalky enamel); teeth may have slight signs of wear.
4. Marked effect: definite mottling, staining, and hypoplasia; may have pitting of enamel; definite wear of teeth; enamel may be pale cream color.
5. Excessive effect: definite erosion of enamel with excessive wear of teeth: staining and pitting of enamel may or may not be present.
8. Missing.
9. Deciduous tooth.

The number and percentage of individuals examined receiving a #2 (Slight Effect) or higher valuation are shown in the following chart:

Farm	Distance & Direction	Number Examined	Number with Dental Symptoms	%
Snell	4 $\frac{1}{2}$ miles - South	8	0	0
Cristy	5 $\frac{1}{2}$ miles - East	8	1	12.5%
Anderson	4 miles - S.W.	5	4	80%

The examinations revealed the cattle to be free from skeletal Fluorosis. There were a number of individuals demonstrating an early Fluorotic dental pattern indicating sufficient intake to cause staining and mottling of incisor teeth, but not sufficient to cause a loss of productivity at the present rate of intake.


John B. Crum, D.V.M.

EXAMINATION OF ANIMALS FOR FLORIDE TOXICOSIS

[illegible]

[illegible]

2-87

LEARNING OF ANIMALS FOR FLUORIDE TOXICISTS

[illegible]

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2.3 TOPOGRAPHY

2.3.1 GENERAL TOPOGRAPHIC SETTING

Most of Hamilton County lies within the Central Highlands Region of Florida. This is a moderately flat, poorly drained region that ranges in elevation from about 50 feet above mean sea level (MSL) in areas of stream dissection to about 150 feet (MSL) in the Highlands. The county is drained by the Alapaha, Withlacoochee and Suwannee Rivers (Figure 2.3-1). The eastern part of the county, where the Occidental property lies, is drained by the Suwannee River. As shown in Figure 2.3-2, a reproduction of the United States Geological Survey (USGS) map of the area, the eastern part of the county is characterized by a low degree of topographic relief, except in areas of stream dissection. Drainage basins of some of the major creeks in the area are outlined on Figure 2.3-1.

2.3.2 SWIFT CREEK DRAINAGE BASIN

The proposed Swift Creek Chemical Plant lies within a moderately flat area at approximately Elevation 140 feet (MSL) on the west side of the watershed of Swift Creek, a tributary of the Suwannee River. A map of Swift Creek drainage is shown in Figure 2.3-3.

Swift Creek drains a relatively flat upland plateau in a piney woods environment. The rim of the plateau area varies generally from an elevation of 133 feet to 140 feet (MSL). The high point along the rim rises to 153 feet (MSL) at the extreme west edge of the basin. The northwest half of the drainage area is dominated by a regional surficial depression, "Swift Creek Swamp," which forms the headwaters of Swift Creek. The bottom of Swift Creek Swamp is approximately 120 feet above mean sea level with its outlet at the northwest corner of Section 10, Township 1S, Range 15E. The natural outlet is wide and flat, with a low point of 121 feet (MSL), indicating regular drainage and shallow ponding.

The channel of Swift Creek begins at the outlet of Swift Creek Swamp and falls at an average rate of 7.5 feet per mile for 5 miles then plunges in the last 2 miles at a rate of approximately 17 feet per mile to the Suwannee River, which lies at an elevation of about 50 feet (MSL). For the first 2½ miles, the Swift Creek channel is cut only 5 to 8 feet into the surrounding plateau. As the stream approaches what was probably the original rim of the plateau, the channel is cut 30 to 50 feet deep. Below an elevation of 110 feet (MSL), many springs associated with the shallow water-table aquifer line the channel of Swift Creek. The natural drainage areas above pertinent stations on Swift Creek are presented in Table 2.3-1.

The drainage area of Swift Creek has undergone certain natural and man-made changes. At some time prior to man's occupation of the area, Bee Haven Bay could have drained south into Swift Creek Swamp. The added runoff could well account for the deeply incised lower channel of the present Swift Creek. However, the boundary was field checked and Bee Haven Bay was found to drain north through Rocky Creek. An old resident of the area, who cut timber in Bee Haven Bay for many years, reports that the area has "always" drained north towards Rocky Creek. The US Geological Survey (USGS) report a watershed area of 65.3 square miles for their Gauging Station No. 02315520 at Facil, indicating that they included Bee Haven Bay in the Swift Creek drainage basin. This apparent difference has been reported to the USGS. Considering the mass of data that the USGS must process, it is understandable that it would be impossible for them to field check all drainage boundaries in an area of low relief.

A ditch has recently been excavated parallel to US Highway 41, west of the power line and underground cable. This ditch effectively drains an area of 1.54 square miles of the natural Swift Creek basin (in Sections 26, 27, 34, 35, and 36, Township 1N, Range 14E) into Camp Branch, as shown in Figure 2.3-3. Further, along the west boundary of Swift Creek, current and past mining operations have temporarily added 4.2 square miles of Hunter Creek and 1.3 square miles of Roaring Creek basins to the Swift Creek drainage.

During mining operations, certain areas are occluded from natural drainage. A large part of the intercepted runoff is recirculated in the mining systems, evaporated and/or tied up in phosphatic clays. Excess runoff from these occluded areas is released to Swift Creek through control structures after passing through settling and clarification ponds. The effluent passing through these control structures and monitoring points also includes some water originating from the deep aquifer.

Additional modification of drainage was affected in the early 50's by the timber companies who cut shallow ditches to speed drainage of the swamps. In the 60's and later in 1975, Occidental Chemical Company further lowered and extended these drainage ditches, as shown in Figure 2.3-3. Since the ditches are cut well into the shallow aquifer, the range of the stream channel indicating perennial flow is extended upstream from the original spring line toward the outflow of Swift Creek Swamp.

2.3.3 POST MINING TOPOGRAPHY

Mining operations in Hamilton County began in 1965 at the Suwannee River Mine of Occidental Chemical Company in the eastern portion of the Swift Creek drainage basin and progressed since into portions of the Hunter Creek and Roaring Creek basins. Operations at the Swift Creek Mine of

Occidental began in 1975. Approximately 6000 acres have already been involved in mining activities. The majority of the mined areas are in use for clay settling and water storage; the remainder of the land has been or is in the process of being reclaimed. Both mines are expected to remain active for many years and should, therefore, impact additional portions of the Swift Creek drainage basin.

The principal streams originating in the general mining vicinity are Swift, Hunter, Rocky, and Roaring Creeks (Figure 2.3-1). Mining operations have altered the natural drainage of Swift and Hunter Creeks, to a lesser extent that of Roaring Creek, and have not affected Rocky Creek. Natural surface drainage patterns of these streams are not sharply defined and it is very probable that interchange of water between the stream basins occurs naturally in flat areas, depending on the rainfall intensity. Therefore, although mining operations are likely to temporarily alter the basin divides, this should not create significant stresses or impacts on the topographic environment, particularly since Occidental's reclamation plan will proceed in such a way so as to essentially restore the natural drainage boundaries of area streams and creeks.

Projected mining from 1978 through the year 2000 would cover an area of up to 37,000 acres. Of the acreage projected to be mined, approximately

10,500 acres are located in the Swift Creek drainage basin. Land reclamation would, however, be undertaken simultaneously with mining activities so that the disturbed acreage at any one time is only a fraction of the total acreage.

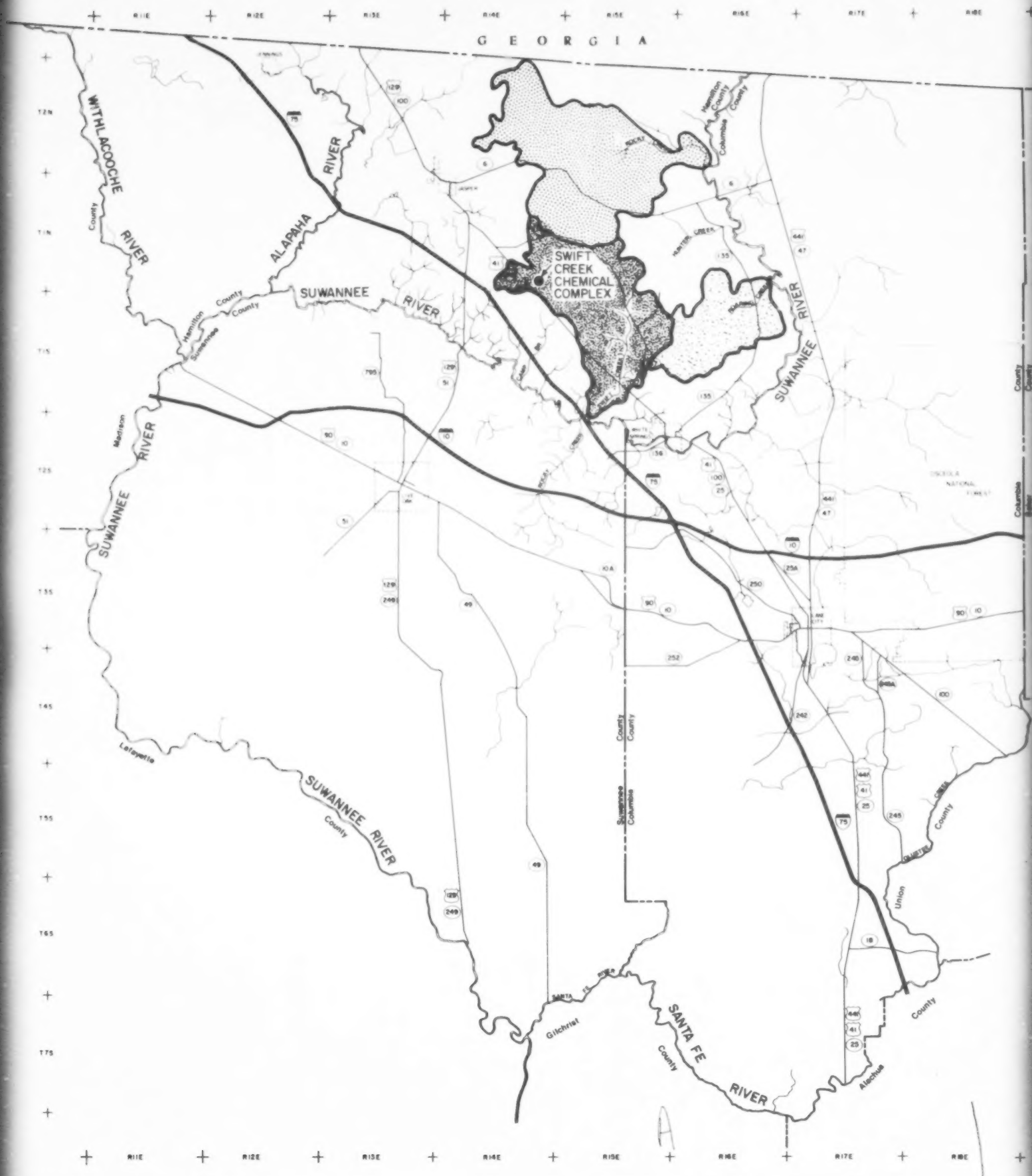
Mining operations and subsequent land reclamation generally result in an alteration of the original topography into a gently rolling topography with occasionally higher land surface elevations. Reclaimed areas also incorporate more surface-water bodies arising from the creation of man-made lakes. For example, a potential reclamation plan by Occidental Chemical Company incorporates 11,500 acres of reclaimed clay settling areas, 10,500 acres of reclaimed sand tailing areas, and 13,000 acres of lakes and re-shaped overburden. Corresponding areas in the Swift Creek drainage basin amount to 5000, 2500, and 2000 acres for reclaimed clay, sand and lake areas, respectively. Sections 2.4.3.3 and 2.5.5 present additional information on the soil characteristics of these reclaimed acres.

TABLE 2.3-1

DRAINAGE AREAS ABOVE PERTINENT POINTS ON SWIFT CREEK

<u>River Miles</u>	<u>Location</u>	<u>EIS Monitoring Stations</u>	<u>Drainage Area Sq. Miles</u>
7.28	Outlet of Swift Creek Swamp at cutoff berm and Occidental control	SC 9.5	20.6
6.55	Road	SC 9*	24.2
6.00	Altman Bay Ditch	SC 8	
5.40	Southern Railroad	SC 7.5*	28.5
5.33	Wooden Bridge	SC 7	
4.10	Sampling Site	SC 6	35.4
2.62	US 41 Bridge, USGS Gauge No. 02315520	SC 4	37.9
0.74	Sampling Site	SC 2	
0.00	Suwannee River	SC 1	41.9

*Stream Gauge Recorder installed in conjunction with this study.





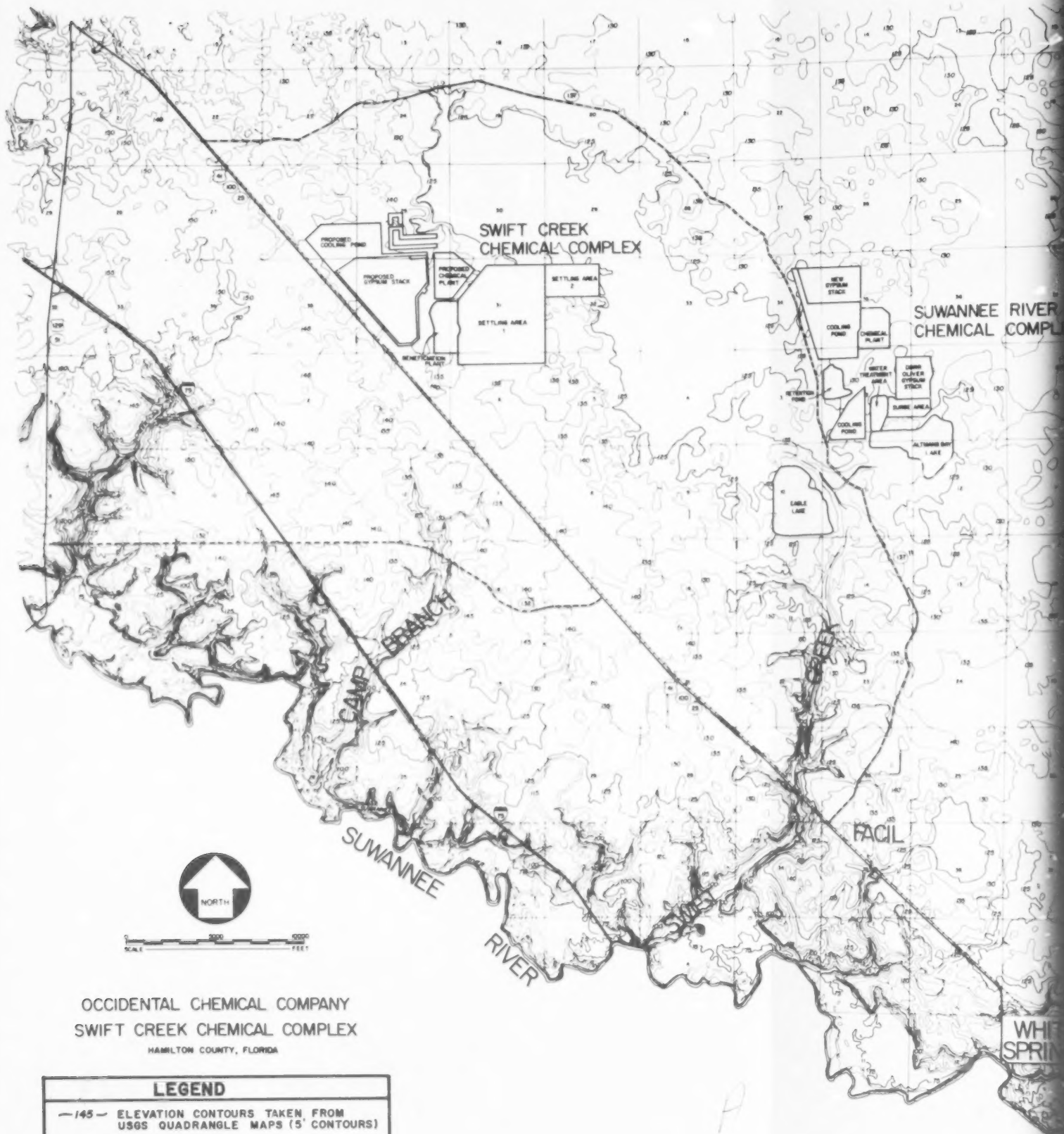
SCALE 0 1 2 3 4 MILES

OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX
HAMILTON COUNTY, FLORIDA

LEGEND	
	SWIFT CREEK DRAINAGE BASIN
	ROARING CREEK DRAINAGE BASIN
	ROCKY CREEK DRAINAGE BASIN

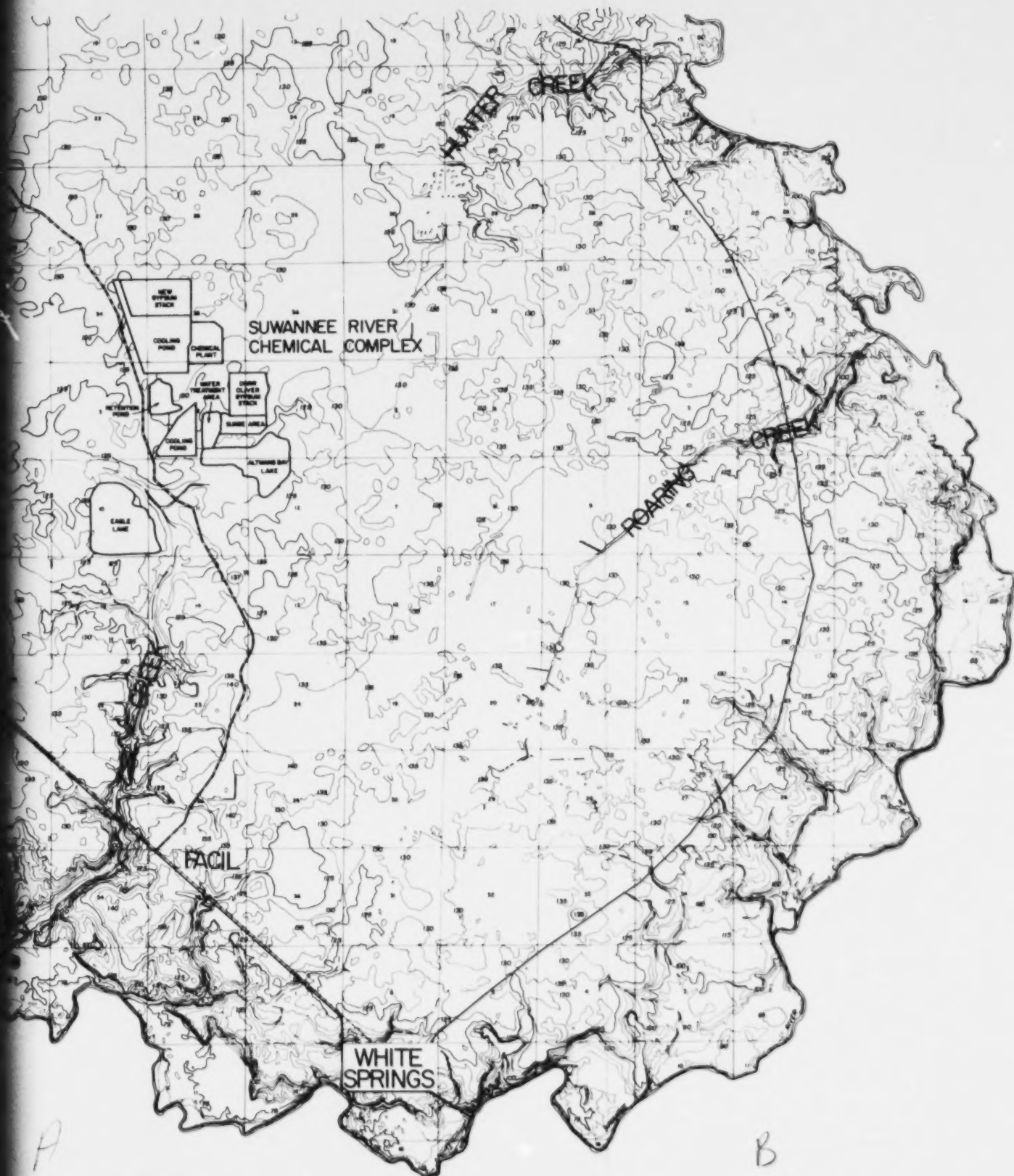
SUWANNEE RIVER
AND TRIBUTARIES

B



OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX
HAMILTON COUNTY, FLORIDA

TOPOGRAPHIC MAP



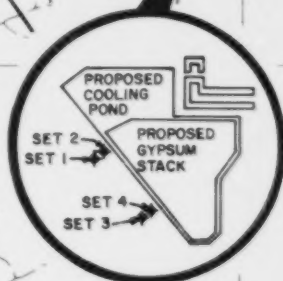
TOPOGRAPHIC MAP

PART OF SWIFT CREEK BASIN
CUT OFF AND DRAINED TO
CAMP BRANCH

"BEE HAVEN BAY"

SWIFT CREEK SWAMP
SWIFT CREEK
CHEMICAL COMPLEX

SUWANNEE RIVER
CHEMICAL COMPLEX



USGS
02315550
SUWANNEE
SPRINGS



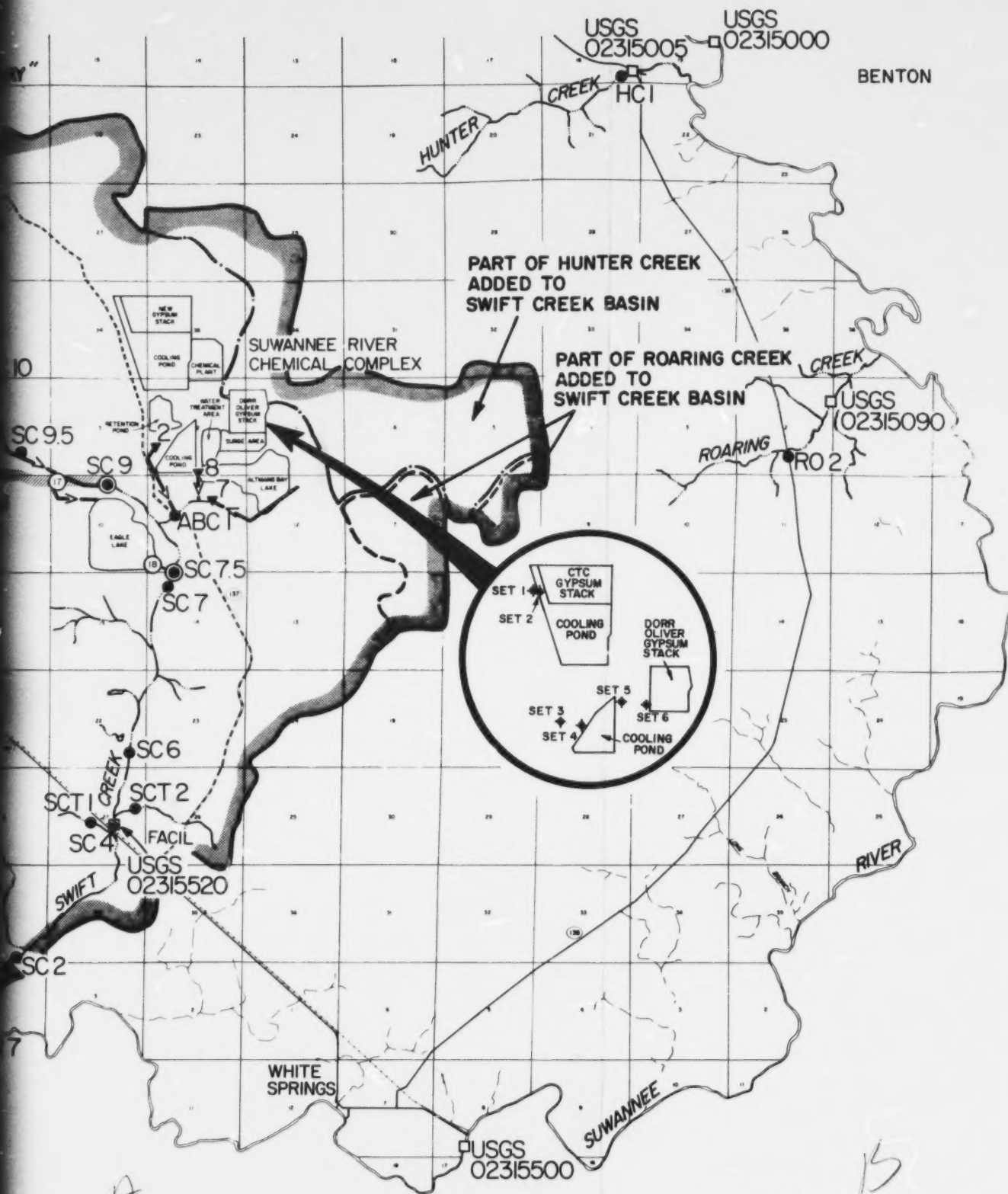
SCALE
0 100 200 FEET

OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX
HAMILTON COUNTY, FLORIDA

LEGEND

- | | |
|---|---|
| EXISTING SWIFT CREEK BASIN BOUNDARY | ● EIS WATER QUALITY SAMPLING SITE |
| → DRAINAGE DITCHES | ○ EIS STREAM GAUGE LOCATION |
| ▼ OCCIDENTAL COMPANY PLUMB WITH RECORDING GAUGE | □ U.S.G.S. STATION |
| ⊙ CONTROL WEIR (OCCIDENTAL) | ◆ OBSERVATION WELL LOCATIONS (each with 3 to 5 piezometers at varying depths) |

SWIFT CREEK DRAINAGE BASIN AND LOCATION OF



DRAINAGE BASIN AND LOCATION OF SAMPLING STATIONS

2.4 GEOLOGY

2.4.1 PHYSIOGRAPHY

The regional geologic setting is within two distinct physiographic divisions, the Northern Highlands and the Coastal Lowlands (see Figure 2.4-1). The boundary between these divisions is an outfacing scarp, the relief of which varies from a gradual to a sharp reduction in elevation.

East of the Suwannee River, the topography in the Northern Highlands is characterized by a gently rolling land surface with elevations ranging from 125 feet to 200 feet (MSL). Because of the presence of low permeability clastic surficial sediments, sinkholes are uncommon in the area (Figure 2.4-2) and shallow, low velocity streams have developed to carry the surface water runoff. As they approach the scarp, the channels are incised into the land surface and as they approach the toe of the scarp, many streams disappear underground into sinks and reappear down-gradient.

Land surface elevation in the Coastal Lowlands varies from sea level at the Gulf Coast to approximately 125 feet (MSL) at the scarp and in

localized areas within the division. Limestone is close to the surface in the Coastal Lowlands and the density of sinkholes is high, especially in the channel of the Suwannee River. The Suwannee River, which is located at or near the toe of the scarp, has a bottom elevation of less than 50 feet (MSL).

The Occidental Chemical Company site is located within the Northern Highlands and is characterized by a relatively flat land surface at elevations ranging between 135 and 145 feet (MSL). Relief at the site is very gentle and generally slopes northeastward toward a regional surficial depression, Swift Creek Swamp, which lies at an elevation of 120 to 125 feet (MSL).

2.4.2 STRUCTURAL FEATURES AND DEPOSITIONAL ENVIRONMENT

Florida, which is part of the eastern Gulf of Mexico sedimentary basin, has been divided into two sedimentary provinces, the clastic facies of Panhandle Florida and the non-clastic facies of Peninsular Florida. Hamilton County lies within, but near the border of the Panhandle Florida clastic depositional environment. The non-clastic facies consist of carbonates and evaporites (limestone, dolomite, anhydrite and

gypsum) and the clastic facies are composed of sandstone, shale, and limestone.

Hamilton County is bordered by two structural features, the Peninsular Arch and the Suwannee Straits, that have controlled the distribution and type of sediments from the Cretaceous to Recent time. The location of these features is shown in Figures 2.4-3 and 2.4-4. The Peninsular Arch, which was formed during the Mesozoic era, trends south-southeast from southeastern Georgia into central Florida. During the Cretaceous, the arch was topographically high and sediments were deposited on the flanks of the structure, but did not completely cover it. Upper Cretaceous and more recent sediments were later deposited over the crest of the arch. The Ocala Uplift, centered in Marion and Levy Counties, occurred on the west flank of the Peninsular Arch during the Tertiary Age.

The Suwannee Strait is a northeast-southwest trough extending from Georgia through the Tallahassee area of Florida to the Gulf of Mexico. The Suwannee Strait formed a natural barrier to the southward transport of clastic sediments and accumulated fine sands, clays, and limestones during the Upper Cretaceous to Lower Eocene time. During this period, clastic sediments were deposited north and northwest of the channel;

these consisted of sandstone and shale. South and southeast of the channel, in the vicinity of Hamilton County, carbonates and evaporites were deposited. By the Middle Eocene, the channel was probably no longer an effective barrier in separating the two facies and the non-clastic facies moved north and northwest over the clastics.

Williams (1971) has postulated that a previously undefined structure, termed the "Lulu Bank," a structural and depositional high, significantly influenced the deposition of commercial phosphorite deposits within the Hawthorn Formation. The Lulu Bank is described as being a long, relatively discontinuous structural high that extends from Putnam County northwestward through the north-central part of Hamilton County and into southern Georgia (Figure 2.4-5). A structural contour map of the first limestone bed in the Hawthorn Formation below the zone of commercial grade phosphate ore, confirms the general trend and dip of the beds presented in Figure 2.4-5 (LaMoreaux, 1977).

Figure 2.4-6 presents a map of the general area incorporating apparent joints and fractures discerned from aerial photographs and substantiated by numerous borings. This information suggests that the site has relatively light fault and fracture patterns. This is consistent with the observation that most karst features and recognizable sinkholes occur in

central and western Hamilton County (Figure 2.4-2) and not so much in the eastern part of the county.

2.4.3 STRATIGRAPHY

2.4.3.1 Regional Stratigraphy

The State of Florida is the emerged portion of a mass of sediments known as the Floridan Plateau. The sediments range in age from early Paleozoic to Recent, and increase in thickness from north Florida to south Florida. A few oil wells have penetrated the sediment layers and encountered crystalline rocks (granites and diorites) of the Pre-Cambrian era. A geologic column giving the approximate age and thickness of the sedimentary units in Hamilton County is presented in Table 2.4-1. The following discussion treats the sedimentary rocks in ascending order.

Paleozoic black shale and grey quartzite sandstone have been encountered in several oil wells drilled in Columbia and Suwannee Counties, and in southeastern Georgia. Although available data is limited, these sediments are apparently part of an extensive deposit in north and central Florida and southeast Georgia. In Hamilton County, the top of the

Paleozoic sediments occurs from -3,600 to -3,800 feet (MSL). Intrusions of diabase and basalt, attributed to the Triassic Age, have been encountered within or overlying Paleozoic sediments.

Argillaceous sands, red-brown shale, greenish sandy shale, and sandy limestone compose the undifferentiated lower Cretaceous sediments which unconformably overlie the Paleozoic at an elevation of -3,300 to -3,400 feet (MSL). These sediments are thin on the flanks of the Peninsular Arch, and may not occur as a thick deposit in Hamilton County.

The Gulf series of late Cretaceous Age includes the Atkinson Formation (which consists of beds of Woodbine Age and beds of Eagle Ford Age), beds of Austin Age, beds of Taylor Age and limestone beds of Navarro Age. Beds of Woodbine Age are micaceous sand with interbedded shale and limestone, while the beds of Eagle Ford Age are predominantly marine shales. The top of the Atkinson Formation most likely occurs at -3,100 to -3,200 feet (MSL) in Hamilton County. Chalk and marl compose the beds of Austin Age, which have a fairly uniform thickness of 200 to 350 feet in Peninsular Florida. Beds of Taylor Age consist of pasty cream to gray chalk with thin seams of calcareous clay and marl in the Panhandle, and grade into hard white to cream limestone over most of Peninsular Florida. These beds probably are 400 to 500 feet thick in Hamil-

ton County. The Lawson Limestone consists of beds of Navarro Age in Peninsular Florida. Two members are recognized in the Lawson Limestone, a white to cream chalky limestone lower member and an upper member with white to cream colored calcitic limestone impregnated with gypsum. The Lawson Limestone ranges from 350 to 500 feet in thickness.

The sediments deposited during the early and middle Tertiary system (Paleocene, Eocene and Oligocene) consist primarily of marine limestone. Generally, the marine limestones deposited in the mid to late Eocene and the Oligocene Age are highly permeable and form the Floridan Aquifer, the primary source of water for most of north-central Florida. Contours of the top of the Floridan Aquifer are shown in Figure 2.4-7. The late Tertiary sediments of Miocene Age are composed predominantly of clays and clayey sands which act as semi-confining beds to the Floridan Aquifer.

The Cedar Keys Formation of Midway Age (Paleocene Series) disconformably overlies the Cretaceous Age sediments. The majority of this formation is grey to brown limestone impregnated with gypsum and anhydrite, but the lower portion is dolomitic and a distinct marker bed of clay occurs near the middle of the formation. The Cedar Keys Formation is approximately 400 feet thick in Hamilton County.

The Oldsmar Limestone of Wilcox Age overlies the Cedar Keys Formation. The top of the formation appears as a brown limestone with gypsum and anhydrite beds, while the lower portion is dolomitic. The formation is approximately 300 feet thick in Hamilton County. In the Panhandle, clastic sediments replace the Oldsmar Limestone because of the influence of the Suwannee Straits.

The Lake City Limestone of Clairborne Age (Eocene Series) overlies the Oldsmar Limestone and unconformably underlies the Avon Park Limestone. The Lake City Limestone grades laterally into unnamed clastic sediments in western Florida. It is on the order of 500 feet thick in Hamilton County, and appears as tan to cream limestone, occasionally dolomitized and peat-flecked. The Lake City Limestone is the lowermost Floridan Aquifer unit.

The Avon Park Limestone of Clairborne Age is a cream to brown marine limestone which is approximately 200 to 250 feet thick in Hamilton County. Again, equivalent age clastic sediments were deposited in the Panhandle while the marine deposition took place in Peninsular Florida. The Suwannee Straits served as the dividing influence between the two depositional environments.

The Ocala Group of Late Eocene Age consists of three limestone formations of similar characteristics. In ascending order these are the Inglis Formation, the Williston Formation, and the Crystal River Formation. The Williston Formation and Inglis Formation have been treated as members of the Moody's Branch Formation. The Ocala Group ranges from cream to white porous limestone at the top to a brown to dark brown limestone at the base. The Ocala Group is approximately 300 feet thick in Hamilton County with the top of the Ocala Group at approximately mean sea level in the site area.

The Suwannee Limestone of late Oligocene Age unconformably overlies the Ocala Group and is unconformably overlain by sediments of Miocene to Recent Age. The Suwannee Limestone of Peninsular Florida is a cream colored, porous, soft limestone. In places it appears as a brown to grey dolomitic or cherty limestone. It contains seams of dark olive clay along bedding planes and within vertical solution pipes. The formation is apparently unconformable owing to erosion.

Three time-rock divisions make up the Miocene Series; however, only sediments of Middle Miocene Age appear in Hamilton County. Deposition of middle Miocene sediments in Florida occurred in a wide variety of continental, deltaic, and marine environments. Two formations within

the middle Miocene have been identified in Hamilton County: the Hawthorn Formation and the Alachua Formation.

The most important of the Miocene units in the study area is the Hawthorn Formation. The Hawthorn Formation, which was deposited in a shallow marine environment, is primarily composed of layers of grey to green sandy phosphatic clay, phosphatic sand and phosphatic limestone. The upper portions, generally above 90 feet (MSL), contain the commercial phosphate deposits. The lower, more clayey portions, act as confining beds separating the surficial deposits from the Floridan Aquifer. Deposits of Miocene sandstone and limestone are generally included as the basal part of the Hawthorn Formation.

The Alachua Formation, which is contemporary with and slightly more recent than the Hawthorn Formation, occurs in some locations in Hamilton County. It is a terrestrial deposit, possibly lacustrine and fluvial. The base of the Alachua Formation usually consists of a rubble of phosphate rock and silicified limestone in a matrix of cream clay. A varying thickness of very pale orange to light grey clayey sand with phosphate overlies this material. Light greenish and bluish clay lenses are present.

Sediments of Pleistocene Age, deposited in terraces during fluctuations of sea level in the "Glacial Age," form prominent topographic features along the East Coast of the United States. The terraces formed by the fluctuating seas, their shoreline elevations and tentative ages are given in Table 2.4-2. Note that each successive shoreline is lower than the preceding one, so that a succession of terraces is formed. The scarp discussed in Section 2.4.1 is actually the Wicomico shoreline.

Because the site area has a general elevation of 135 to 145 feet (MSL), sediments of the Coharie and Okefenokee or Sunderland may also be present. It is likely that the Sunderland/Okefenokee sediments dominate, since erosion deposition of sands and clayey sands would have usually occurred close to the coastline.

Recent series sediments are still forming along the Florida coastline and in lakes. In Hamilton County, alluvium is being deposited in stream flood plains, peat is forming in lake basins, and loose quartz sands are being washed into drainage valleys and solution depressions.

2.4.3.2 Site Specific Stratigraphy

A total of ten 100-foot to 160-foot deep Standard Penetration Test (SPT)

borings and numerous shallow SPT borings (<50 feet deep) were made to determine the nature of the deposits underlying the proposed site. A boring location plan, boring logs, and results of laboratory tests on subsurface soils are presented in Appendix A2.4.1. In addition, a continuous 300-foot deep core boring was made at the site to determine the formation contacts and to better define the characteristics of the confining layers. US Geological Survey personnel observed the coring and assisted in determining the formation contacts. The geologic log and a gamma ray log for the deep core hole are presented in Figure 2.4-8.

The boring log profiles indicate that the stratigraphy is fairly uniform, although localized variations exist. The surficial deposits in the vicinity of the proposed site overlie the phosphate-bearing ore matrix and are composed of a heterogenous mixture of sand, silt, and clay. The uppermost deposit, varying in thickness from 3 to 15 feet and averaging about 5 feet, is generally a fine-grained quartz sand to silty fine sand. Located between this layer of fine sand and the phosphate ore matrix are layers of low permeability deposits, ranging in thickness from 5 to 15 feet, which are composed primarily of silty to clayey sands and sandy clays overlying silty sands. Near the base of these post-Miocene sediments, phosphatic material is generally present.

From borings made at the proposed site, the top of the ore matrix was found to occur at depths ranging from 10 to 30 feet below land surface with an average depth of approximately 20 feet corresponding to Elevation 120 feet (MSL). The ore matrix is composed of phosphatic material interbedded with sand, clay and some limestone and forms the uppermost layer of the Hawthorn Formation. From a number of holes drilled at the site, the material directly underlying the phosphate ore matrix was determined to consist primarily of clayey sands and sandy clays with thin interbedded lenses of limestone and quartz sand. Further inspection of the cores taken at the site revealed that the horizontal and vertical solution features found within the limestone in the Hawthorn Formation, below the ore matrix, were very tightly filled with low permeability material composed of a sandy clay to clay.

The Hawthorn Formation has been divided by Miller et al (1977), into distinct lithologic units which have been assigned informal designation as lettered members. Figure 2.4-8 shows the following Hawthorn Formation members to be present at the site:

Member A: This uppermost Hawthorn unit is highly variable consisting of sands and clayey sands with clay and limestone, phosphatic throughout. At a depth ranging from 25 to 55 feet below the

surface, the first limestone layer is encountered. Contours of this first bedrock layer are shown in Figure 2.4-9. This layer forms the lowermost boundary to which phosphate is currently being mined in Hamilton County because digging indurated material is not economically feasible. Member A, with an overall thickness of about 47 feet, extends below the minable matrix and consists at these lower depths of fossiliferous limestone and some phosphate interbedded with layers of soft clay.

Member B: This unit consists of massive plastic clay layers alternating with layers of soft limestone with shells and traces of phosphate interbedded with massive clayey silts and clayey fine sand. It is approximately 19 feet thick.

Member C: This unit is 30 to 35 feet thick and consists of layers of fine sand to clayey sand, rubbly limestone interbedded with layers of clay and incorporating solution pipes tightly filled with clay and clayey sands, as well as clayey sands and sandy clays with seams of sand and calcareous rock.

Member D: This variable unit consists of fine-grained well-indurated

and calcareous sandstone as well as of mottled clay and sands, calcareous, with soft to indurated sandy limestone. It is only 9 feet in thickness.

Four of the five Hawthorn Formation members present in the Osceola National Forest (Miller et al, 1977) are also recognizable at the Occidental site. Member E, the basal Hawthorn unit which was encountered in the Osceola National Forest, some 20 miles southeast of the Occidental site, and which consisted of sandstone, limestone, dolomite, and argillaceous limestone, is absent at the Occidental site.

The Suwannee Formation, considered to underlie the Hawthorn Formation at the site, is composed of a relatively soft, white to grayish, sandy limestone layer with prominent seams and pockets tightly filled with stiff green clay overlying a hard fossiliferous limestone with thin seams of clay. The Suwannee Limestone is about 16 feet thick with its base located at approximately mean sea level. This formation was not encountered in the Osceola National Forest (Miller et al, 1977).

A generalized profile of the subsurface conditions at the site is presented in Table 2.4-3. This profile is based on the numerous SPT borings, the 300-foot core hole and boring logs available from Occiden-

tal supply wells. Figure 2.4-10 shows a stratigraphic cross-section constructed using the geologic log of the deep core hole and the geologic logs prepared by the Florida Bureau of Geology for two existing wells, W-7053 and W-6836, located approximately 5 miles due east of the proposed plant site. As can be seen, the Hawthorn Formation which separates the Floridan Aquifer from the surficial deposits, is a relatively thick unit, over a hundred feet thick beneath the Occidental property, with its base located approximately at 14 feet (MSL). The Suwannee limestone is relatively thin. It is important to note that the stratigraphy is uniform in the study area, and that geologic conditions at the proposed plant are very similar to those at the existing Suwannee River Chemical Complex which is located 5 miles due east of the proposed plant site.

The Ocala Group underlying the Suwannee Limestone, is composed of a gray to white, soft calcarenite and hard limestone layers with occasional thin lenses of clay at shallower depths. The base of the Ocala was not encountered in the 300-foot deep core hole, which was drilled to approximately Elevation -160 feet (MSL). However, in Well W-7053, the base of the Ocala group was located at a depth of -300 feet (MSL).

In Well W-7053, the Avon Park Limestone was found to be about 115 feet

thick with its base located at approximate Elevation -412 feet (MSL). The material composing the Avon Park Limestone consisted primarily of a gray to dark brown dolostone and a light yellow-orange calcilutite.

Well W-7053 penetrated a 600-foot thick layer of Lake City Limestone with its base at approximately 1,000 feet below mean sea level. The material encountered was described as mainly light yellow-orange calcilutite, with yellowish tinted dolomite.

The Oldsmar Formation was encountered beneath the Lake City Limestone. The formation consists of light to dark yellow-brown dolomite and light yellow-orange calcarenite and calcilutite.

There is no site specific information concerning the geology of the units underlying the Oldsmar Limestone. However, it is believed that the description of these units included in the regional geology section adequately describes these units at the site.

2.4.3.3 Post Mining Conditions

Current mining of phosphate ore in Hamilton County and subsequent reclamation alter the natural stratigraphy to a maximum depth of about

55 feet. The 10-to 30-foot thick overburden is removed with a dragline and side-cast in adjacent cuts. Then the ore matrix, averaging 20 feet in thickness is mined, slurried, and processed in the beneficiation plant to produce the phosphate concentrate which is either sold or further processed in a chemical plant. The beneficiation plant washing and flotation processes selectively separate the waste matrix products into sand and clay. The sand, comprising 57 percent of the matrix material, is slurry-pumped to sand tailing disposal areas within mined-out pits while the clay waste, which comprises 23 percent of the matrix material, is pumped into settling-storage areas also within and above the mined-out pits. Both the sand tailing and waste clay areas are ultimately reclaimed. None of these activities adversely affect the integrity of the primary Hawthorn confining bed and the underlying Floridan Aquifer limestone.

2.4.4 SITE SUSCEPTIBILITY TO SINKHOLES

Local structural features contribute to the solution of the underlying limestone. Appendix A2.4.2 reviews, in some detail, processes of cavern and sinkhole development in Florida. The presence of joints or fractures in the underlying limerock is one of the factors that are condu-

cive to the development of sinkholes. They become more important where two such fracture patterns intersect, because the possibility of localized solutioning is then increased. Figure 2.4-6 presents a map of the general area incorporating apparent joints discerned from aerial photographs for each county and substantiated by the logs of numerous borings in these counties. This information suggests that the site has comparatively light fault and fracture patterns and, therefore, the potential for solution cavities is expected to be low.

Fracturing is only one factor contributing to the likelihood of sinkhole activity. Figure 2.4-2 considers other parameters such as overburden thickness and divides the state into various zones of sinkhole potential. As shown, the site is located along the western perimeter of an area identified as least probable for sinkhole activity.

Even though the potential for formation of modern sinkholes is low, some solutioning certainly has occurred during the geologic past. These resulting ancient sinkholes have been masked by the re-deposition of clastic sediments.

This investigation has not conclusively identified any sinkholes, but surface topography can be found indicating the probable presence of

ancient karst features which reflect through the overburden soils. Two such possibilities can be inferred from USGS topographic maps and aerial photographs in the north and northwest portion of Section 25 Township 1N, Range 14E. Several near-circular depressions, both dry and water filled, can be found in other areas, notably in the northern portion of Section 32, and central and western parts of Section 6, Township 1S, Range 15E.

Other suspected sinkholes or dolines can be inferred from examining the contours of the surface of the first rock stratum in the area. The rock stratum occurs at a depth of 25 to 55 feet throughout the Swift Creek site. Two striking examples of suspected dolines can be observed in the southeast of Section 36, Township 1N, Range 14E (see Figure 2.4-9).

The practical implication of this information is that whereas sinkholes have occurred in the geologic past in the site vicinity, current hydro-geologic conditions are such that the site is in an area with a very low probability of sinkhole occurrence.

2.4.5 EARTHQUAKE SUSCEPTIBILITY

Florida has experienced no damaging earthquakes. The recorded earthquake pattern in the southeastern United States appears to follow a SE-NW band from Alabama to Maryland and includes an extension perpendicular to that band which covers South Carolina. Several ground movements of Intensity V and VI (minor damage) on the Modified Mercalli scale have apparently been experienced in northern Florida. The Modified Mercalli Intensity Scale covers a full range from I to XII (motions undetected by people to total damage).

Howell (1975) separated the United States into geologically similar provinces and, using the recorded earthquakes in each area, calculated an Average Regional Seismic Hazard Index. This index predicts the Modified Mercalli intensity of the hundred-year earthquake for the region. The Atlantic Seaboard Province and Gulf Coast Province boundary occurs near Hamilton County. The predicted hundred-year Modified Mercalli Intensity of these two provinces is approximately 6.5, with a standard deviation of 0.8 to 0.9. According to Howell, this means that in any $1/2^\circ$ by $1/2^\circ$ quadrilateral, an earthquake of Modified Mercalli Intensity of 6.5 can be expected once per century. An epicentral intensity of 6.5 can be crudely correlated (i.e., through rather poor

correlations) to an earthquake of magnitude 5.2 and a ground acceleration of approximately 0.06g. Magnitude, unlike intensity, is a direct measure of the overall strength of an earthquake (an increase of one in magnitude corresponds to a 30-fold increase in energy release). An earthquake of magnitude 5.2 is not expected to cause very severe damage.

The Uniform Building Code has adopted an earthquake experience map (Figure 2.4-11) originally prepared by Algermission (1969). This map indicates that Hamilton County lies within Zone 1, where only minor damage from earthquakes is expected to occur and where the ground acceleration is expected to be less than 0.1g.

TABLE 2.4-1
GEOLOGIC UNITS IN HAMILTON COUNTY, FLORIDA (AFTER MEYER, 1962)

ERA	System	Series	Years Before Present (in thousands)	Geologic Unit	Approximate Thickness (feet)
Cenozoic	Quaternary	Recent	— 11 —	Pleistocene and Recent deposits (undifferentiated)	0-40
		Pleistocene	— 500 to 2,000 —	Unconformity Atachua Formation Hawthorn Formation	0-150
	Tertiary	Miocene or Pliocene	— 13,000 —	Miocene sandstone and limestone	0-65
		Miocene	— 25,000 —	Unconformity	0-50
		Oligocene	— 36,000 —	Suwannee Limestone	250-350
		Eocene		Unconformity	200-250
				Ocala Group of Jackson Age	450-550
				Avon Park Limestone of Clairborne Age	250-350
				Lake City Limestone of Clairborne Age	250-350
				Oldsmar Limestone of Wilcox Age	400-450
		Paleocene	— 58,000 —	Cedar Keys Formation of Midway Age	350-500
Mesozoic	Cretaceous		— 63,000 —	Unconformity	400-500
				Lawson Limestone of Navarro Age	200-350
				Beds of Taylor Age	0-200
				Beds of Austin Age	0-200
Paleozoic	Cretaceous	Gulf		Atkinson Formation	0-200
				Beds of Eagle Ford Age	0-200
	Triassic			Beds of Woodbine Age	0-200
		Comanche	— 135,000 —	Unconformity	0-40
Paleozoic	Silurian or Devonian		— 230,000 —	Red beds of shale and sand	0-40
				Unconformity	0-40
		Upper Silurian or Lower Devonian		Igneous intrusion	0-40
				Black shale and quartzite sandstone	0-40

TABLE 2.4-2

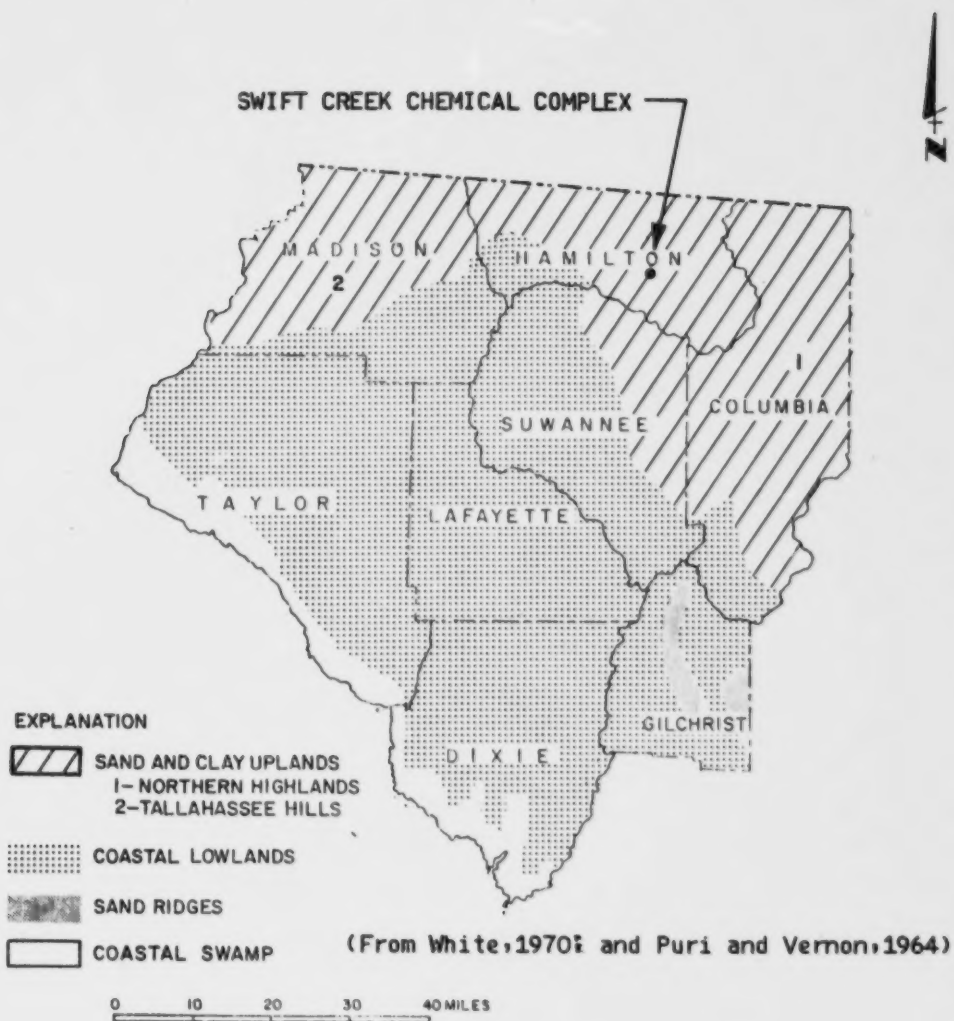
TERRACES FORMED BY FLUCTUATING SEAS

Age	Terrace and Shoreline Elevation, MSL
Nebraskan, Glacial Aftonian, Interglacial	Erosion Coharie, 220 feet
Karsan, Glacial Yarmouth, Interglacial	Erosion Okefenokee, 150 feet and/or Sunderland, 170 feet
Illinoian, Glacial Sandgamon, Interglacial	Erosion Wicomico, 100 feet
Early Wisconsin, Glacial Peorian, Interglacial	Erosion Pamlico, 25-30 feet
Late Wisconsin, Glacial Late Wisconsin, Interglacial	Erosion Silver Bluff, 8 feet

TABLE 2.4-3

GENERALIZED PROFILE OF SUBSURFACE CONDITIONS

<u>Depth (feet)</u>		<u>Description</u>
<u>From</u>	<u>To</u>	
0	5	SAND; gray, brown, or yellowish-brown; slightly silty to silty; occasionally cemented; (Pleistocene).
5	19	SAND; brown, grayish-brown, gray or mottled orangish-brown; fine, silty to clayey; (Pliocene).
19	32	SAND; grayish-brown to greenish-gray; fine; phosphatic; clayey in part; upper layers occasionally leached; (Phosphate matrix, Hawthorn Formation, upper Member A).
32	66	LIMESTONE; yellowish-gray to gray; weathered; fossiliferous; phosphatic; interbedded with seams of phosphatic sand and 0.5- to 4.0-foot thick layers of blue gray to greenish-gray clay. (Hawthorn Formation, lower Member A).
66	85	CLAY; light green to dark greenish-gray; plastic; interbedded with soft limestone, clayey silts, and clayey fine sands (Hawthorn Formation, Member B).
85	120	SAND; light greenish-gray; clayey; fine; interbedded with cream to white soft limestone and greenish gray clay. (Hawthorn Formation, Member C).
120	129	SANDSTONE; light gray; well-indurated, calcareous, with seams of gray-green clay. (Hawthorn Formation, Member D).
129	145	LIMESTONE; white to grayish; sandy; soft to hard; fossiliferous with occasional seams of clay. (Suwannee Limestone).
145	445	LIMESTONE; gray to white; soft to hard; fossiliferous; interbedded with soft to hard CALCARENITE (Ocala Group).
445	560	DOLOSTONE; gray to dark brown; interbedded with light yellow orange CALCILUTITE. (Avon Park Limestone).
560	1160	CALCILUTITE; light yellow-orange with light yellow DOLOMITE (Lake City Limestone).

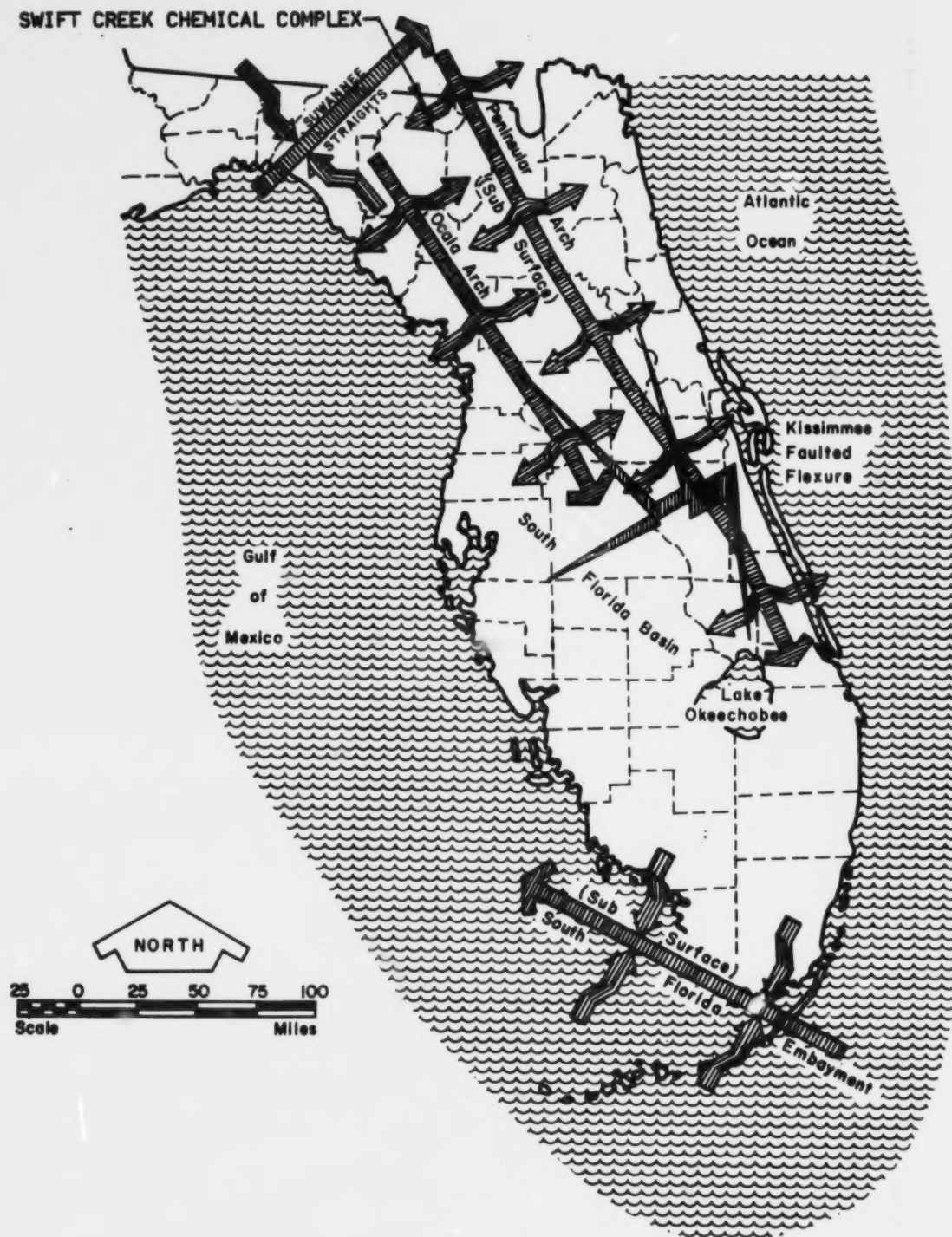


REGIONAL PHYSIOGRAPHY



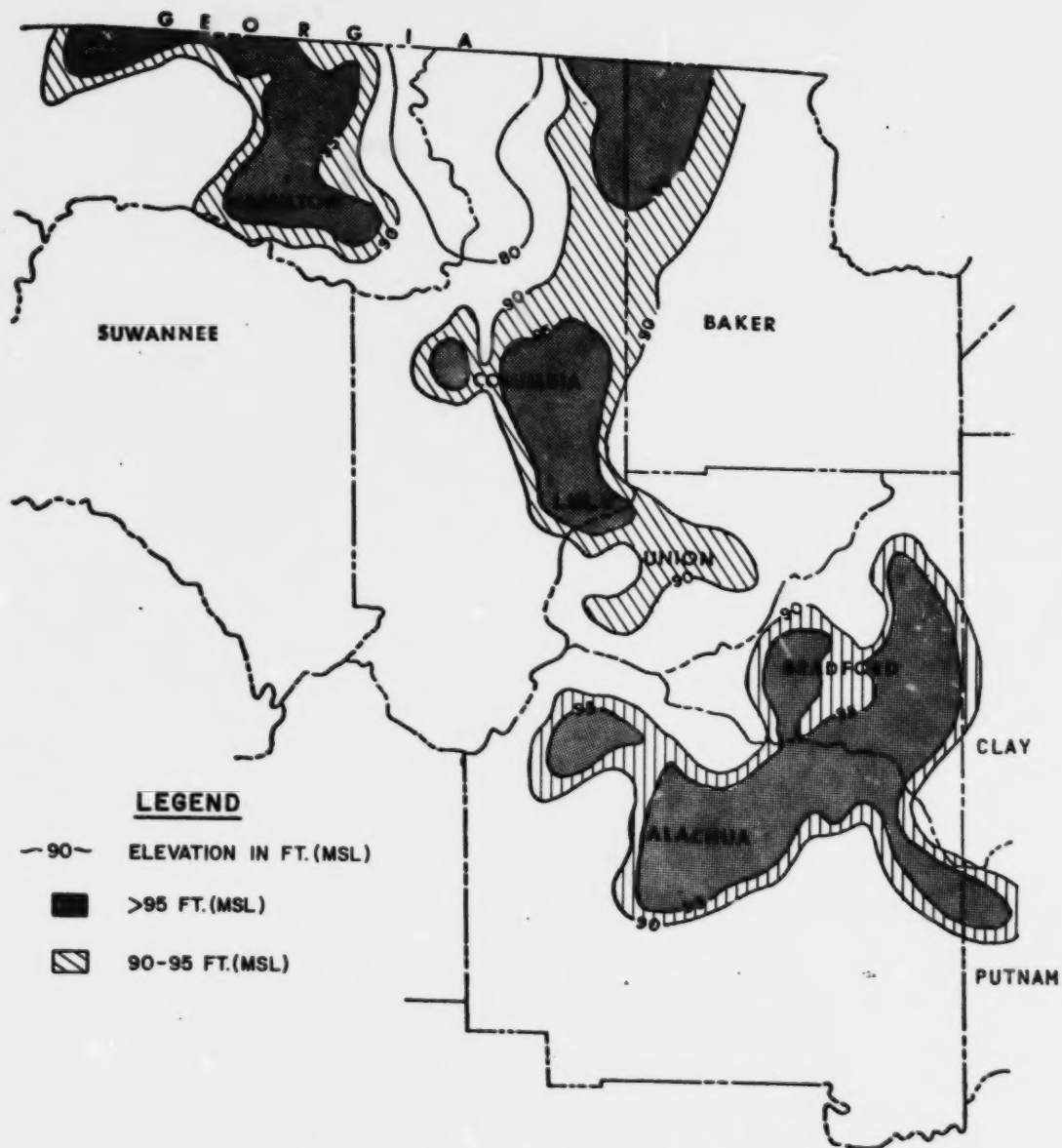
MOST PROBABLE SINKHOLE REGIONS IN FLORIDA

SWIFT CREEK CHEMICAL COMPLEX



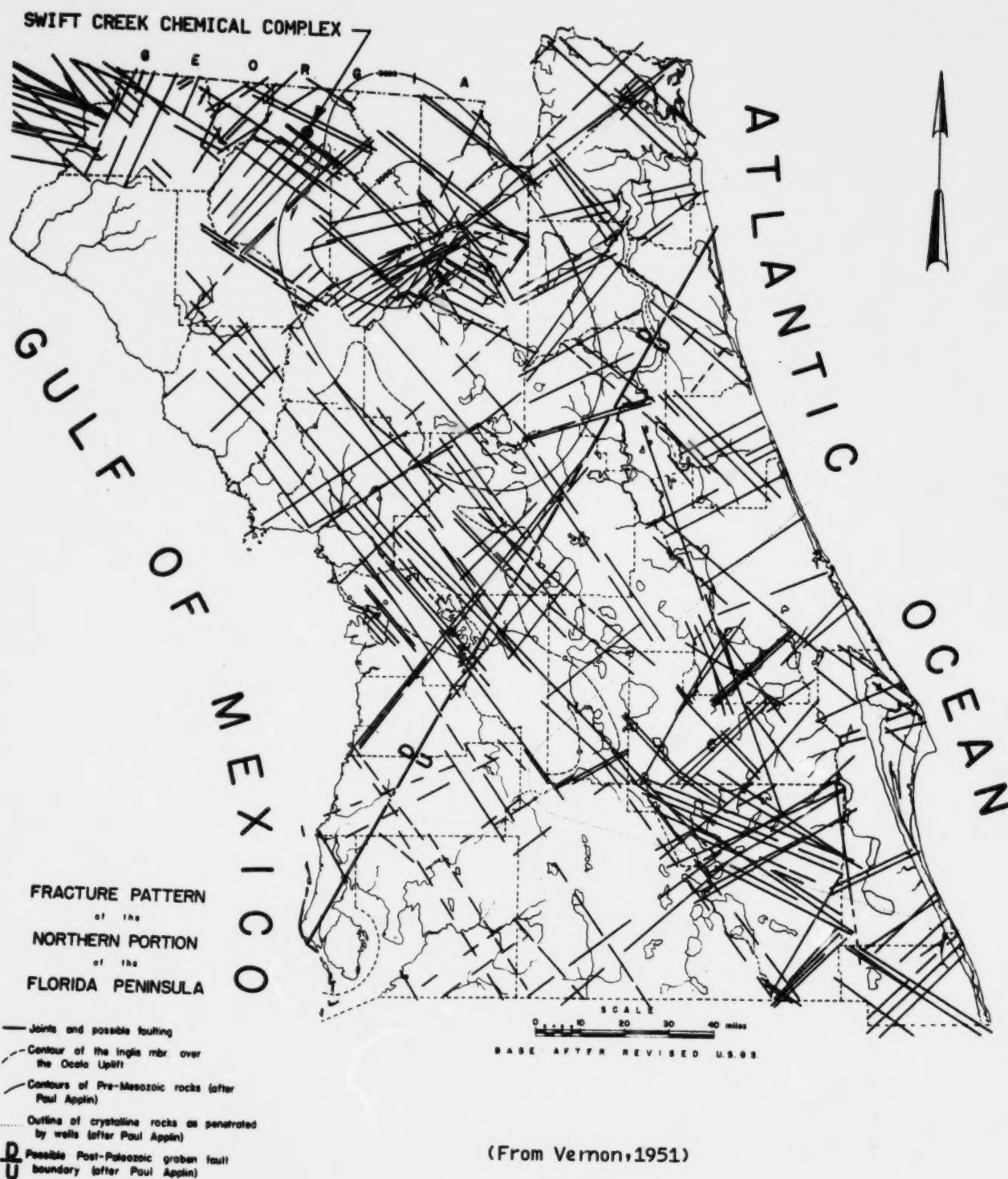
(Modification after Vernon, 1951)

MAJOR STRUCTURAL FEATURES - PENINSULAR FLORIDA

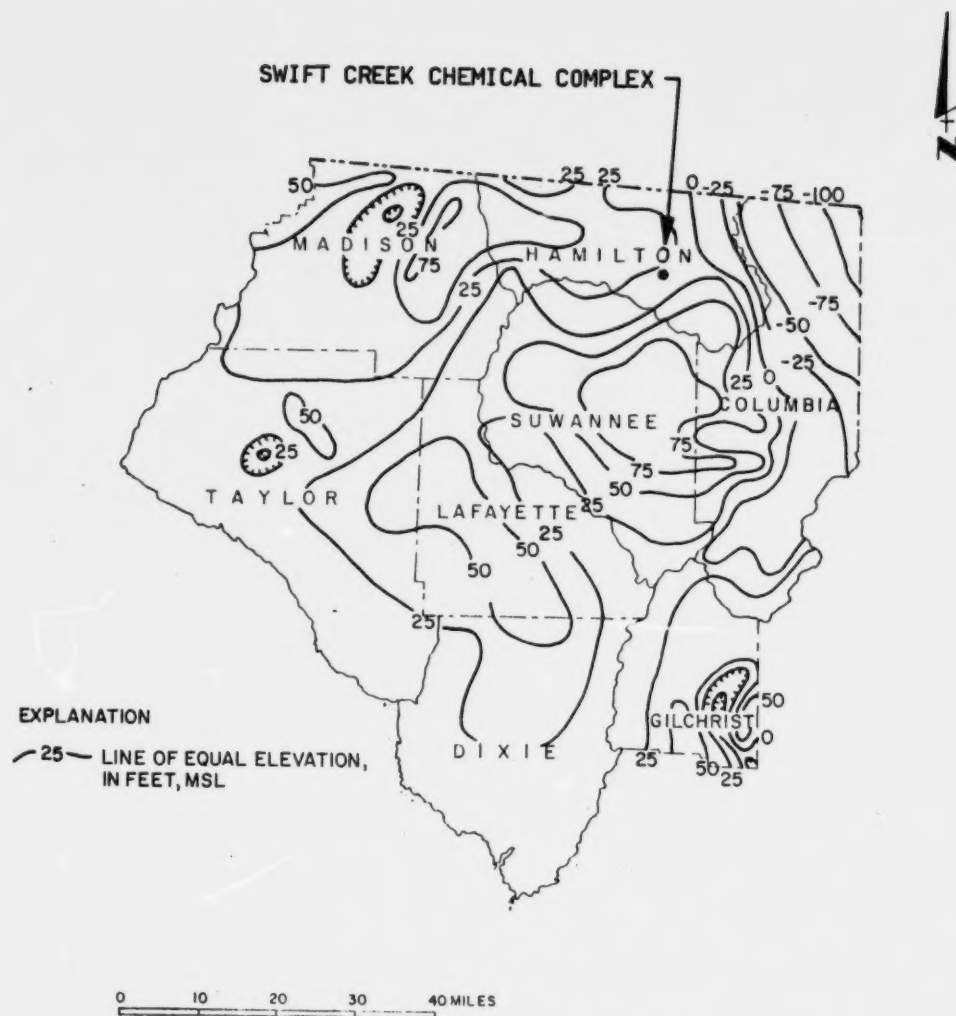


(Modified from Williams, 1971;
LaMoreaux, 1977)

MAP SHOWING CREST OF LULU BANK

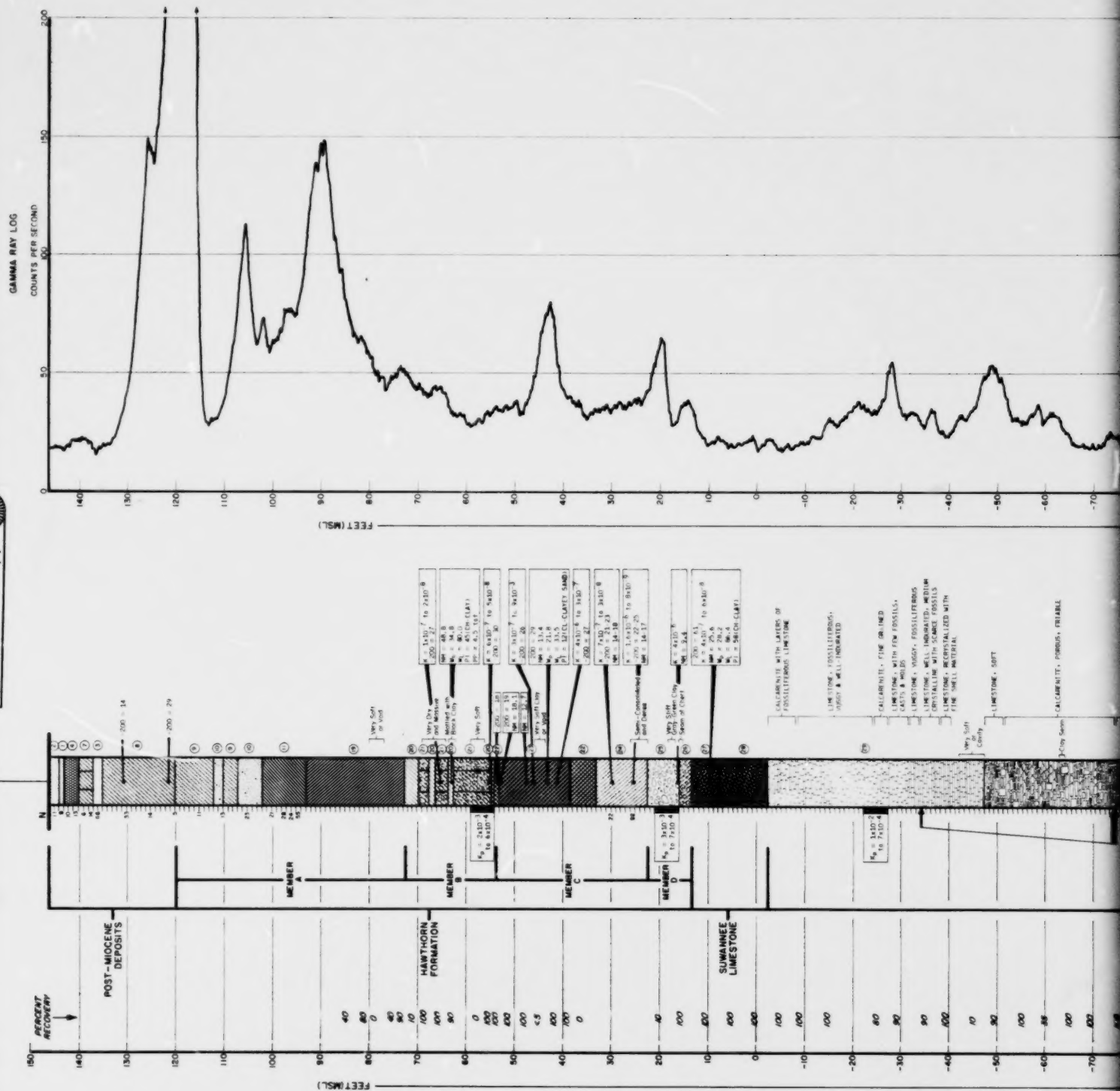


FRACTURE PATTERN



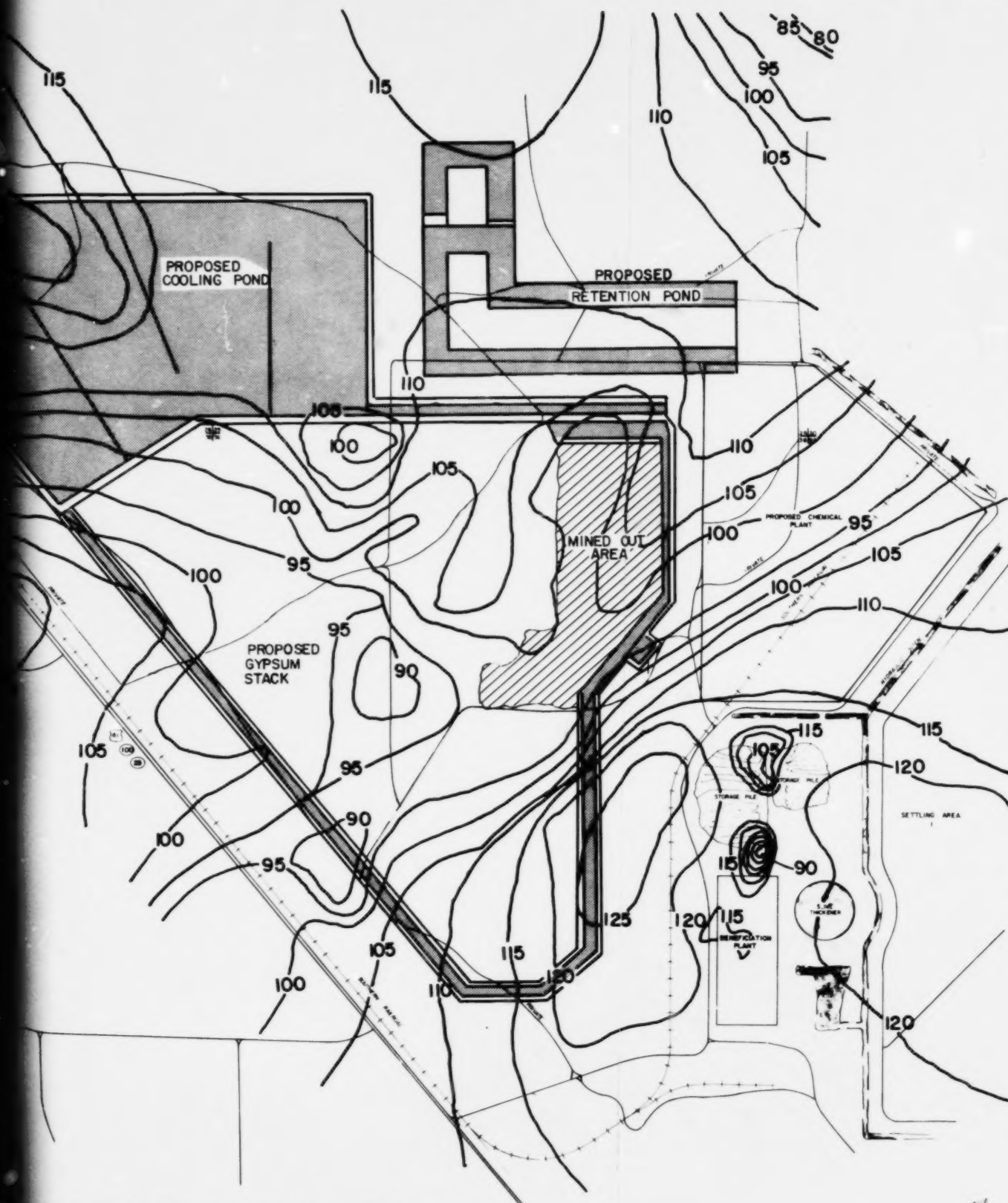
ELEVATION OF THE TOP OF FLORIDAN
AQUIFER LIMESTONE

TEST HOLE
SC-3

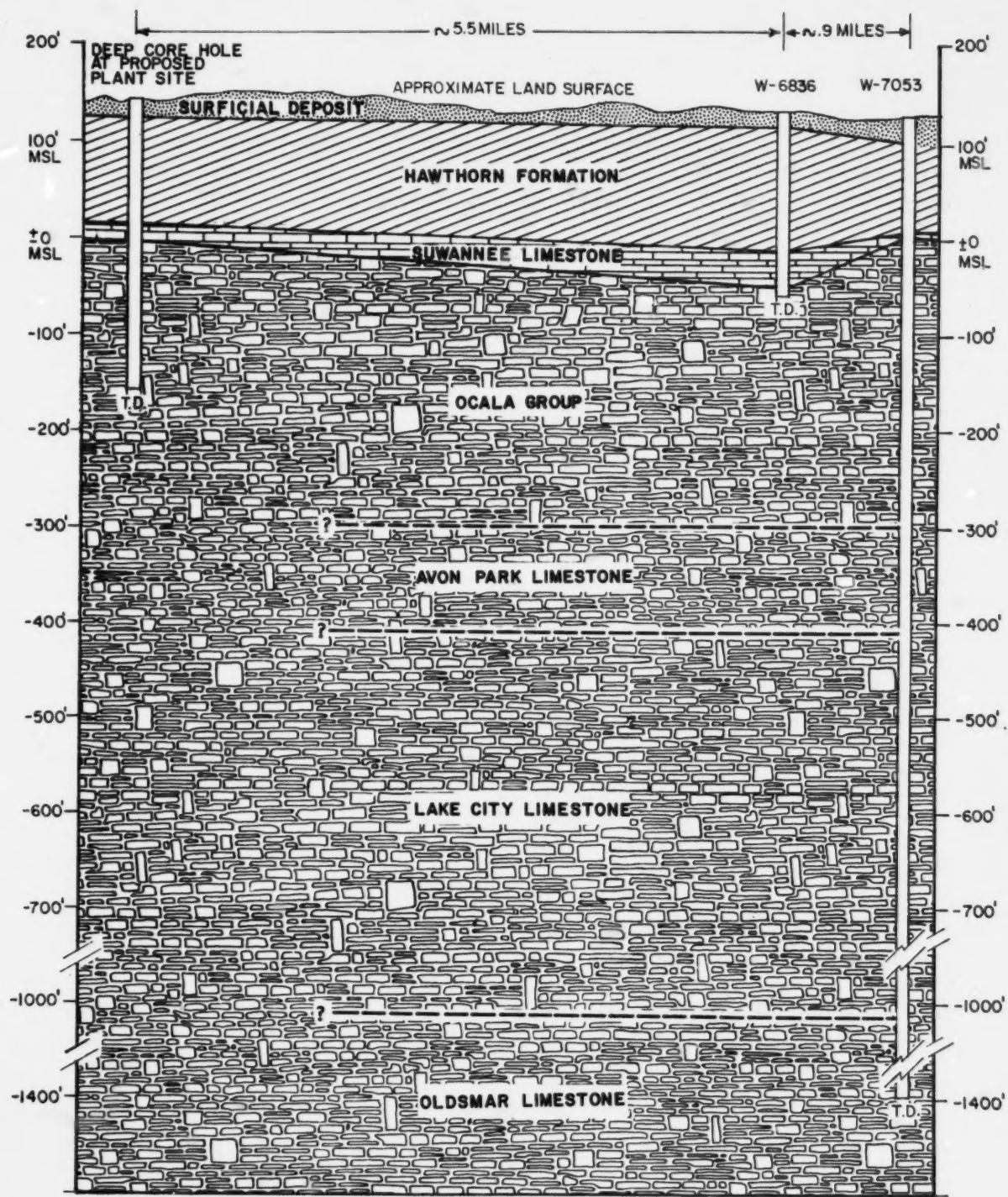




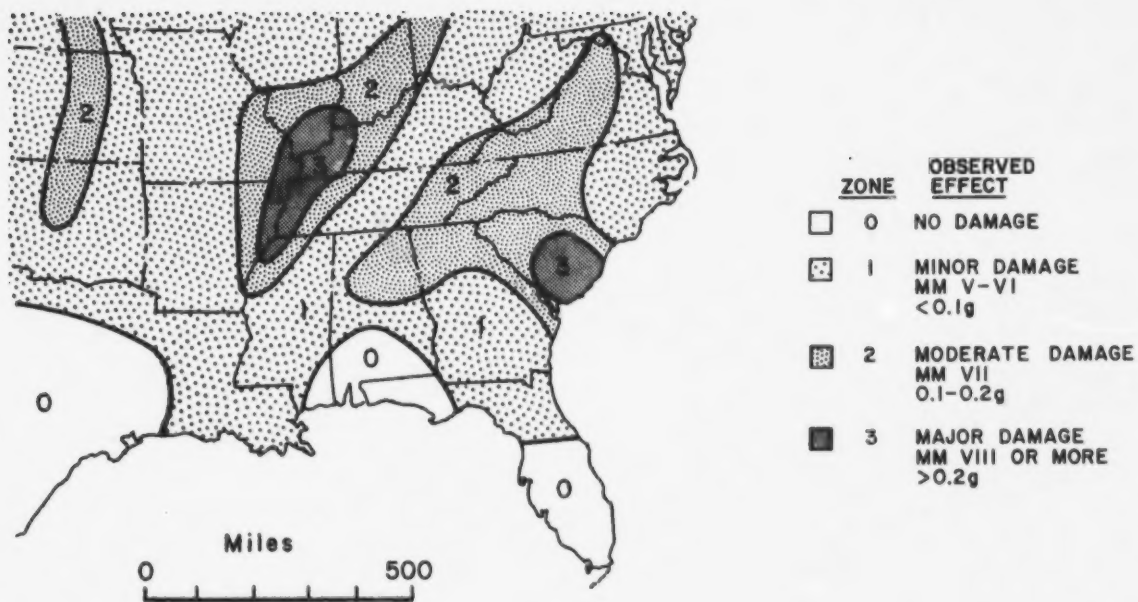
A



HOURS TO FIRST BEDROCK LAYER



GEOLOGIC SECTION AT THE STUDY SITE



(Algermission, 1969, and the Uniform Building Code)

EARTHQUAKE ZONES IN THE SOUTHEASTERN USA

APPENDIX A2.4.1

BORING LOCATION PLAN
AND BORING LOGS
AT PROPOSED SWIFT CREEK
CHEMICAL COMPLEX

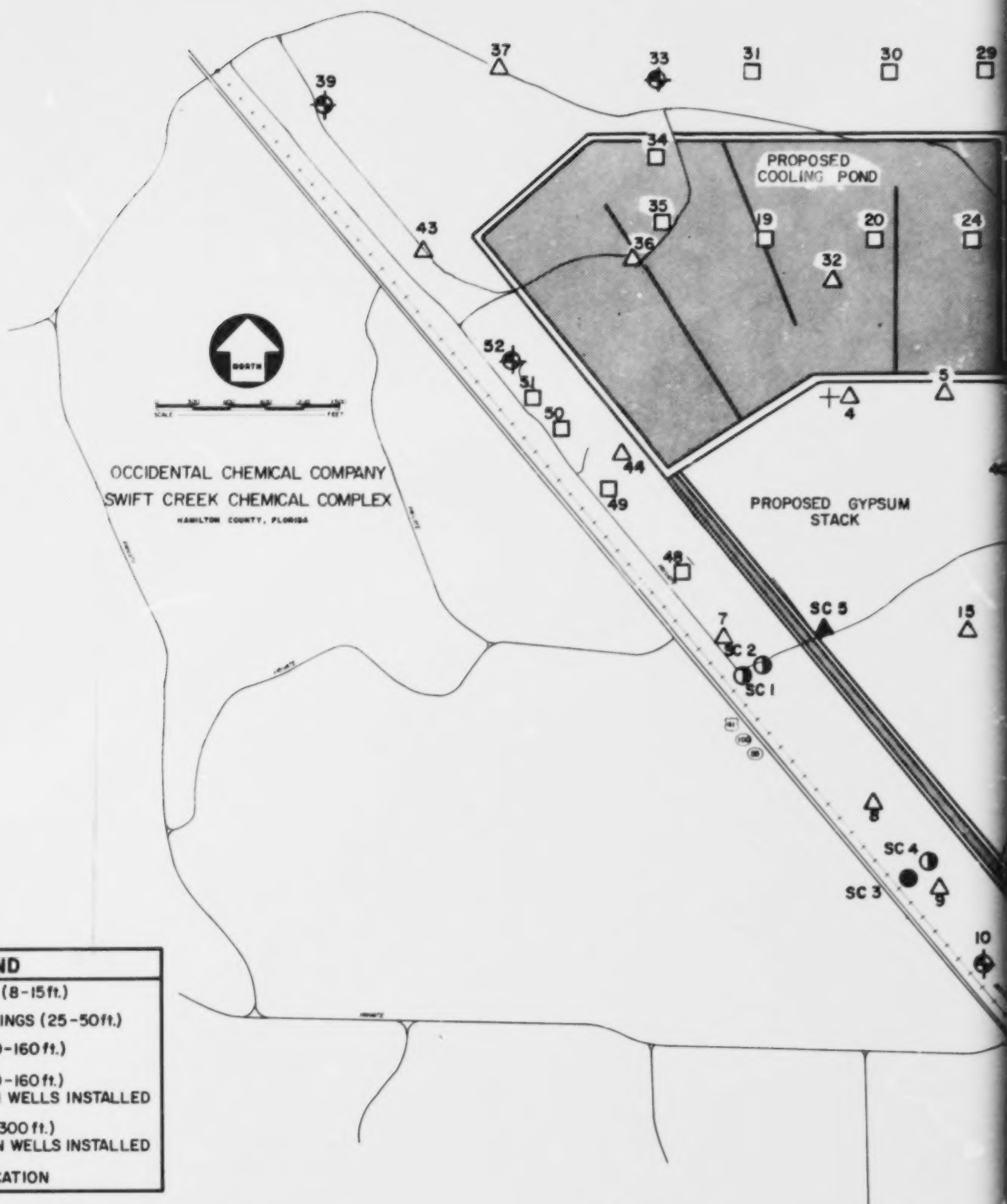
OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX
HAMILTON COUNTY, FLORIDA

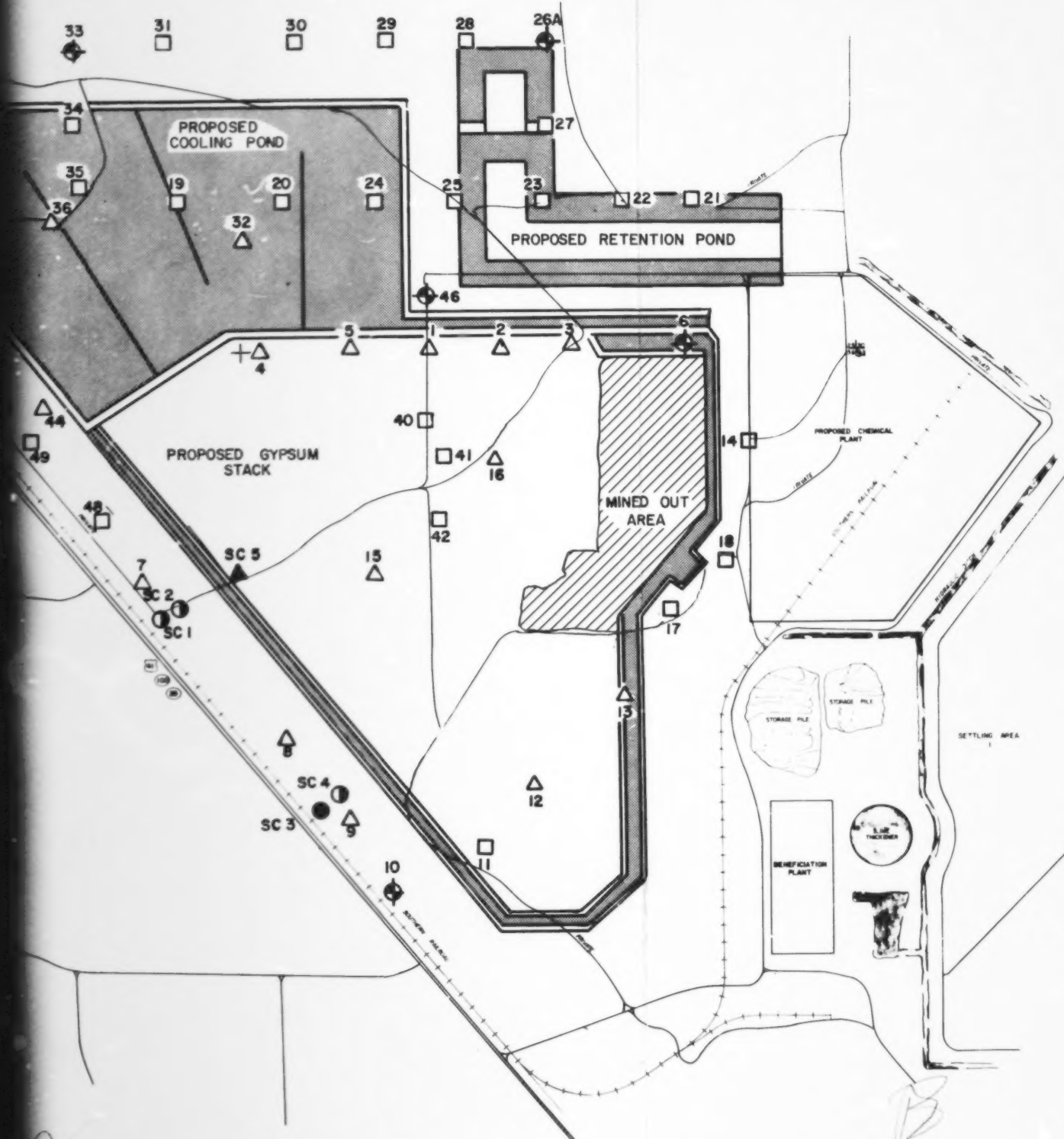


LEGEND

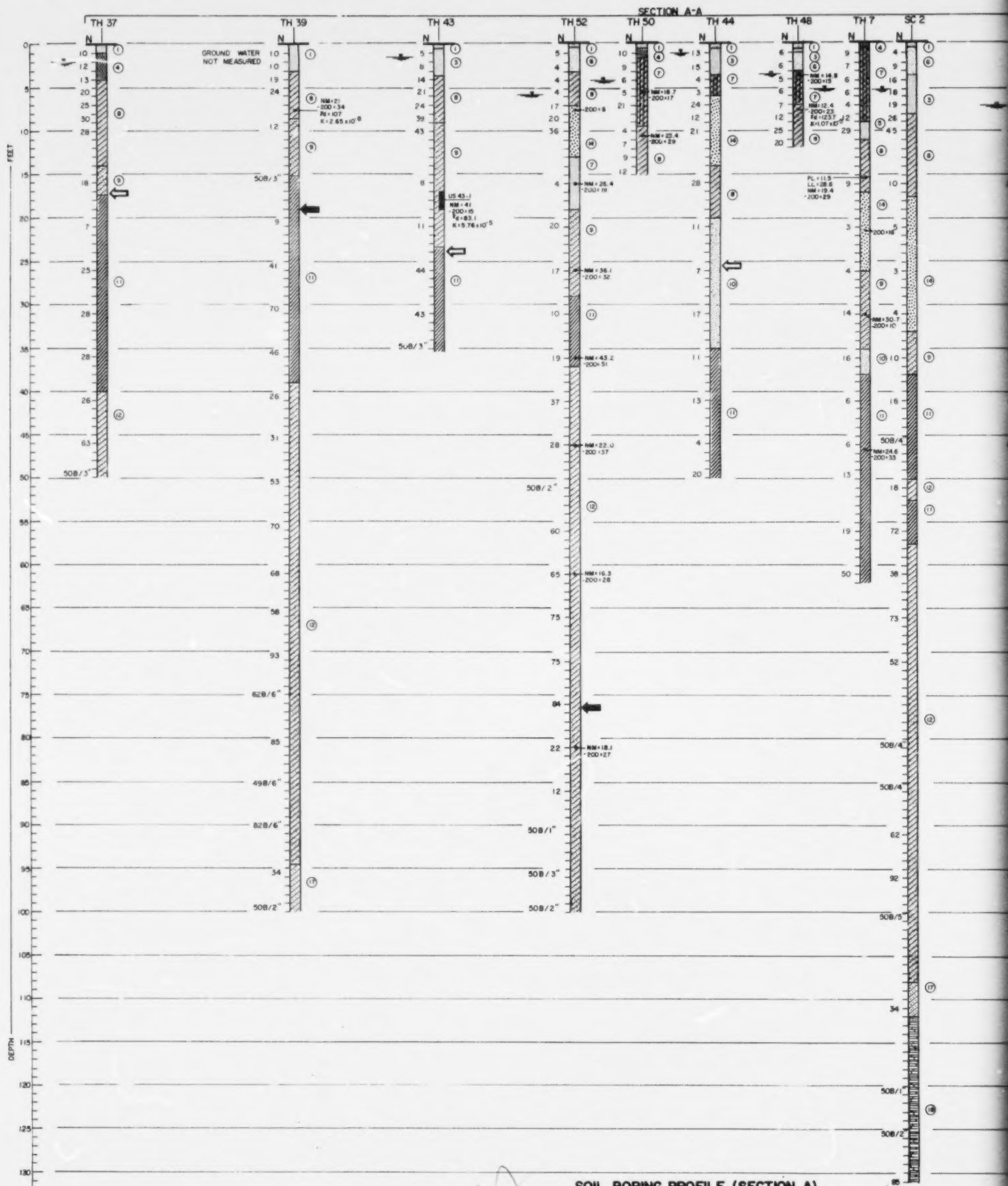
- SHALLOW BORINGS (8-15 ft.)
- △ INTERMEDIATE BORINGS (25-50 ft.)
- ⊕ DEEP BORINGS (100-160 ft.)
- ① DEEP BORINGS (100-160 ft.)
WITH OBSERVATION WELLS INSTALLED
- DEEP CORE HOLE (300 ft.)
WITH OBSERVATION WELLS INSTALLED
- ▲ PUMPING TEST LOCATION

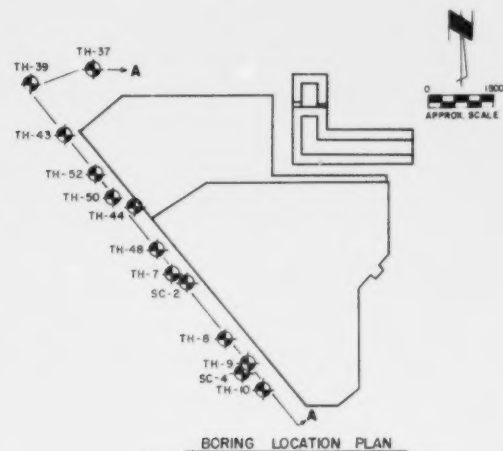
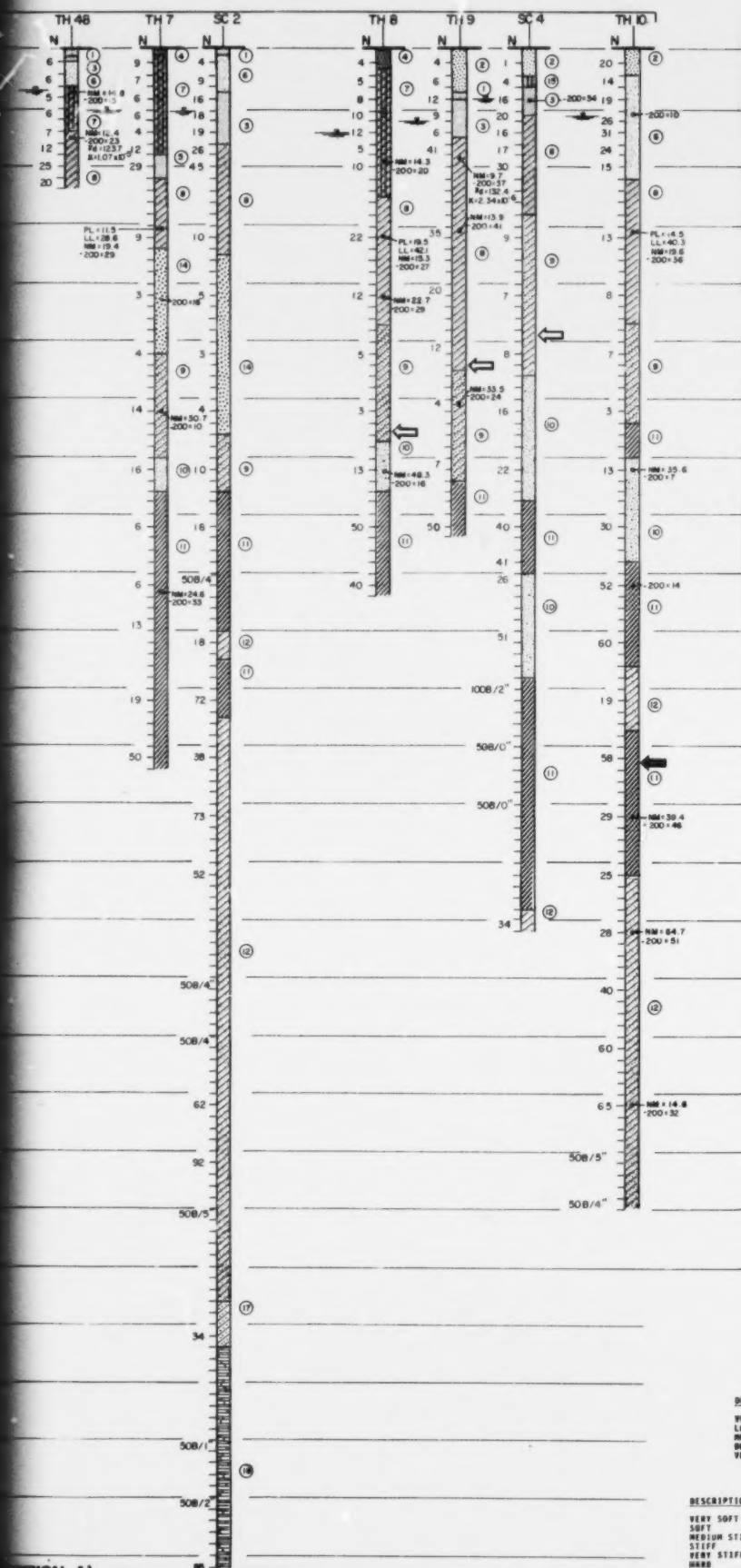
BORING LOCATION PLAN





BORING LOCATION PLAN





LEGEND

- ① GRAY TO DARK GRAY FINE SAND WITH ROOTS (TOPSOIL)
- ② MIXED BROWN AND GRAY FINE SAND (FILL)
- ③ LIGHT GRAY FINE SAND
- ④ LIGHT REDDISH BROWN AND DARK BROWN FINE SAND (HARDPAN TYPE)
- ⑤ VERY LIGHT GRAY FINE SAND
- ⑥ LIGHT YELLOWISH BROWN FINE SAND
- ⑦ BROWN TO GRAYISH BROWN SILTY TO SLIGHTLY CLAYEY FINE SAND
- ⑧ LIGHT BROWNISH GRAY CLAYEY FINE SAND MOTTLED ORANGISH BROWN FINE SAND
- ⑨ GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND WITH OCCASIONAL PHOSPHATE
- ⑩ GREENISH GRAY SAND WITH PHOSPHATE (MATRIX)
- ⑪ YELLOWISH GRAY CLAY TO CONSOLIDATED CLAY WITH SEAMS OF SAND MIXED WITH PHOSPHATES
- ⑫ LIGHT GREENISH GRAY CLAYEY FINE SAND WITH CALCAREOUS LAYERS
- ⑬ MIXED BROWN CLAYEY FINE SAND, CLAY AND CONSOLIDATED CLAY
- ⑭ LIGHT BROWN TO WHITE FINE SAND
- ⑮ BLACK SILTY ORGANIC SAND
- ⑯ GRAY SLIGHTLY CLAYEY TO CLAYEY FINE SAND
- ⑰ DARK GREENISH GRAY SLIGHTLY SANDY CLAY
- ⑱ WHITE TO CREAM CALCAREOUS CLAY TO SOFT LIMESTONE
- ⬆ LOCATION OF TEST HOLE
- GROUND WATER LEVEL: 11/16/77 THRU 2/21/78
- N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
- 200 PERCENT PASSING THE NUMBER 200 SIEVE
- NM NATURAL MOISTURE IN PERCENT
- ← PARTIAL LOSS OF DRILLING FLUID CIRCULATION
- LOSS OF DRILLING FLUID CIRCULATION
- US UNDISTURBED SAMPLE FOR LABORATORY ANALYSIS 2.5 IN. O.D. 16 GAUGE SEAMLESS BRASS SHELBY TUBE SAMPLER.
- PL PLASTIC LIMIT IN PERCENT
- LL LIQUID LIMIT IN PERCENT
- K COEFFICIENT OF PERMEABILITY, CM/SEC
- γ_d IN-PLACE DRY DENSITY, PCF

NOTE: THE BORING LOGS AND RELATED INFORMATION REPRESENT SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ONLY AND ON THE PARTICULAR DATE DRILLED.

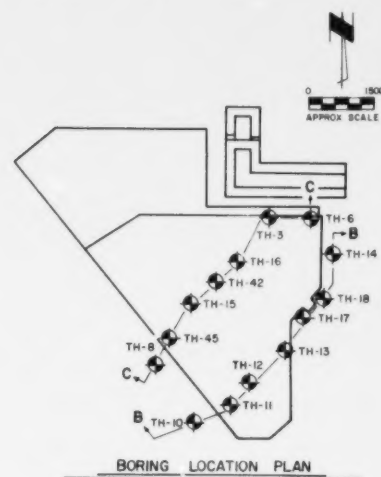
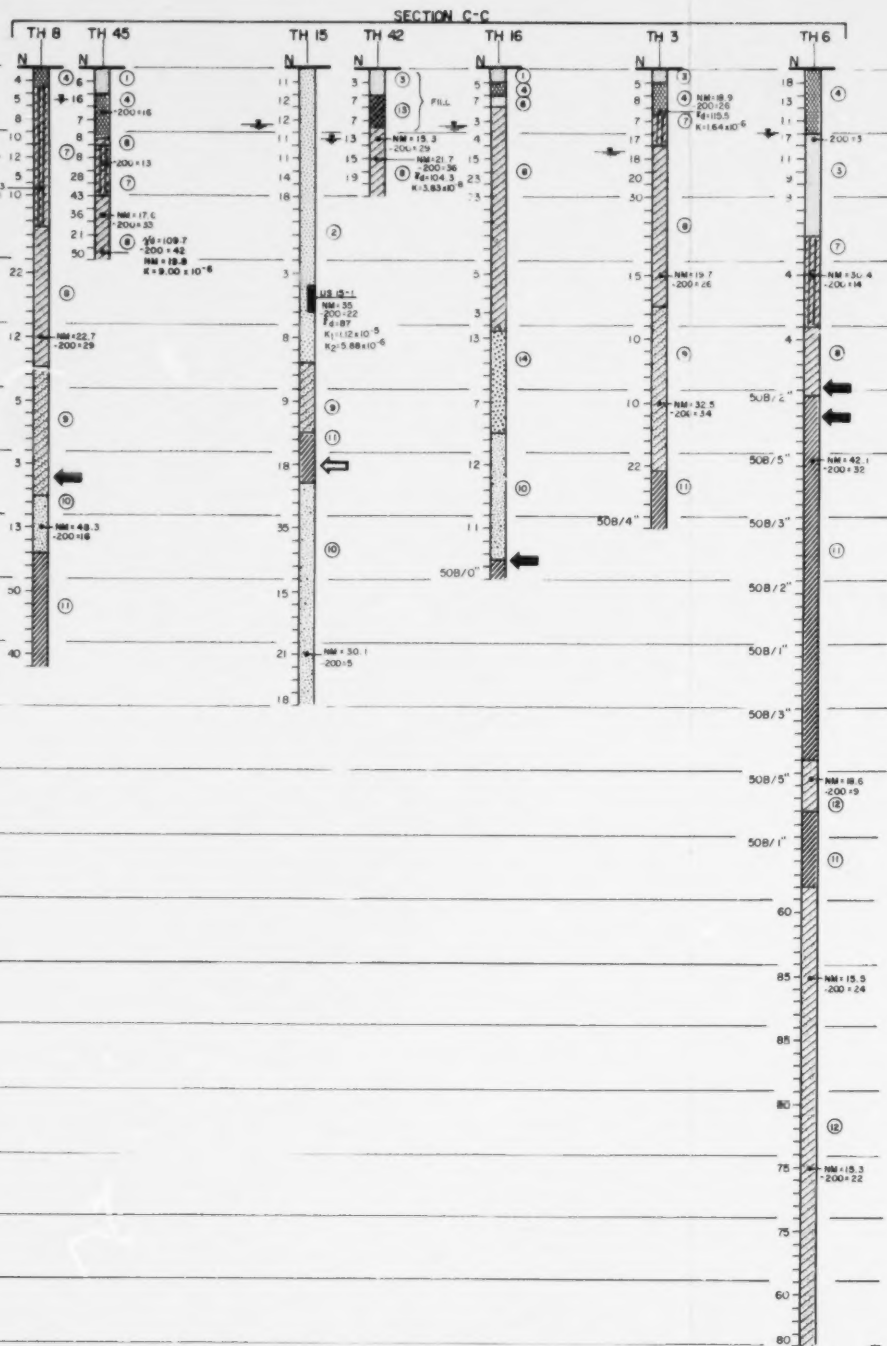
ENGINEERING CLASSIFICATION

1. COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

2. COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 6
STIFF	1 TO 2	6 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30



- LEGEND**
- ① GRAY TO DARK GRAY FINE SAND WITH ROOTS (TOPSOIL)
 - ② MIXED BROWN AND GRAY FINE SAND (FILL)
 - ③ LIGHT GRAY FINE SAND
 - ④ LIGHT REDDISH BROWN AND DARK BROWN FINE SAND (HARDPAN TYPE)
 - ⑤ VERY LIGHT GRAY FINE SAND
 - ⑥ LIGHT YELLOWISH BROWN FINE SAND
 - ⑦ BROWN TO GRAYISH BROWN SILTY TO SLIGHTLY CLAYEY FINE SAND
 - ⑧ LIGHT BROWNISH GRAY CLAYEY FINE SAND MOTTLED BRONZISH BROWN FINE SAND
 - ⑨ GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND WITH OCCASIONAL PHOSPHATE
 - ⑩ GREENISH GRAY SAND WITH PHOSPHATE (D.T.R.I.)
 - ⑪ YELLOWISH GRAY CLAY TO CONSOLIDATED CLAY WITH SEAMS OF SAND MIXED WITH PHOSPHATES
 - ⑫ LIGHT GREENISH GRAY CLAYEY FINE SAND WITH CALCAREOUS LAYERS
 - ⑬ MIXED BROWN CLAYEY FINE SAND, CLAY AND CONSOLIDATED CLAY
 - ⑭ LIGHT BROWN TO WHITE FINE SAND
 - ⑮ BLACK SILTY ORGANIC SAND
 - ⑯ GRAY SLIGHTLY CLAYEY TO CLAYEY FINE SAND
 - ⑰ DARK GREENISH GRAY SLIGHTLY SANDY CLAY
 - ⑱ WHITE TO CREAM CALCAREOUS CLAY TO SOFT LIMESTONE
 - ⬆ LOCATION OF TEST HOLE
 - GROUND WATER LEVEL: 11/28/77 - 2/21/78
 - N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
 - 200 PERCENT PASSING THE NUMBER 200 SIEVE
 - NH NATURAL MOISTURE IN PERCENT
 - ↔ PARTIAL LOSS OF DRILLING FLUID CIRCULATION
 - ↔ LOSS OF DRILLING FLUID CIRCULATION
 - ⬆ CORRESPONDING SAMPLE FOR LABORATORY ANALYSIS 2.5 IN. O.D. 16 GAUGE SCAM-LESS PRESS SHELF-TYPE SAMPLER
 - FL FLATTED LIMIT IN PERCENT
 - LL LIQUID LIMIT IN PERCENT
 - K COEFFICIENT OF PERMEABILITY CM/SEC
 - γ_d IN-PLACE DRY DENSITY PCF

NOTES: THE BORING LOGS AND RELATED INFORMATION REPRESENT THE SUBSURFACE CONDITIONS AT THE INDICATED BORING LOCATION ONLY AND ON THE DATE DRILLED.

ENGINEERING CLASSIFICATION

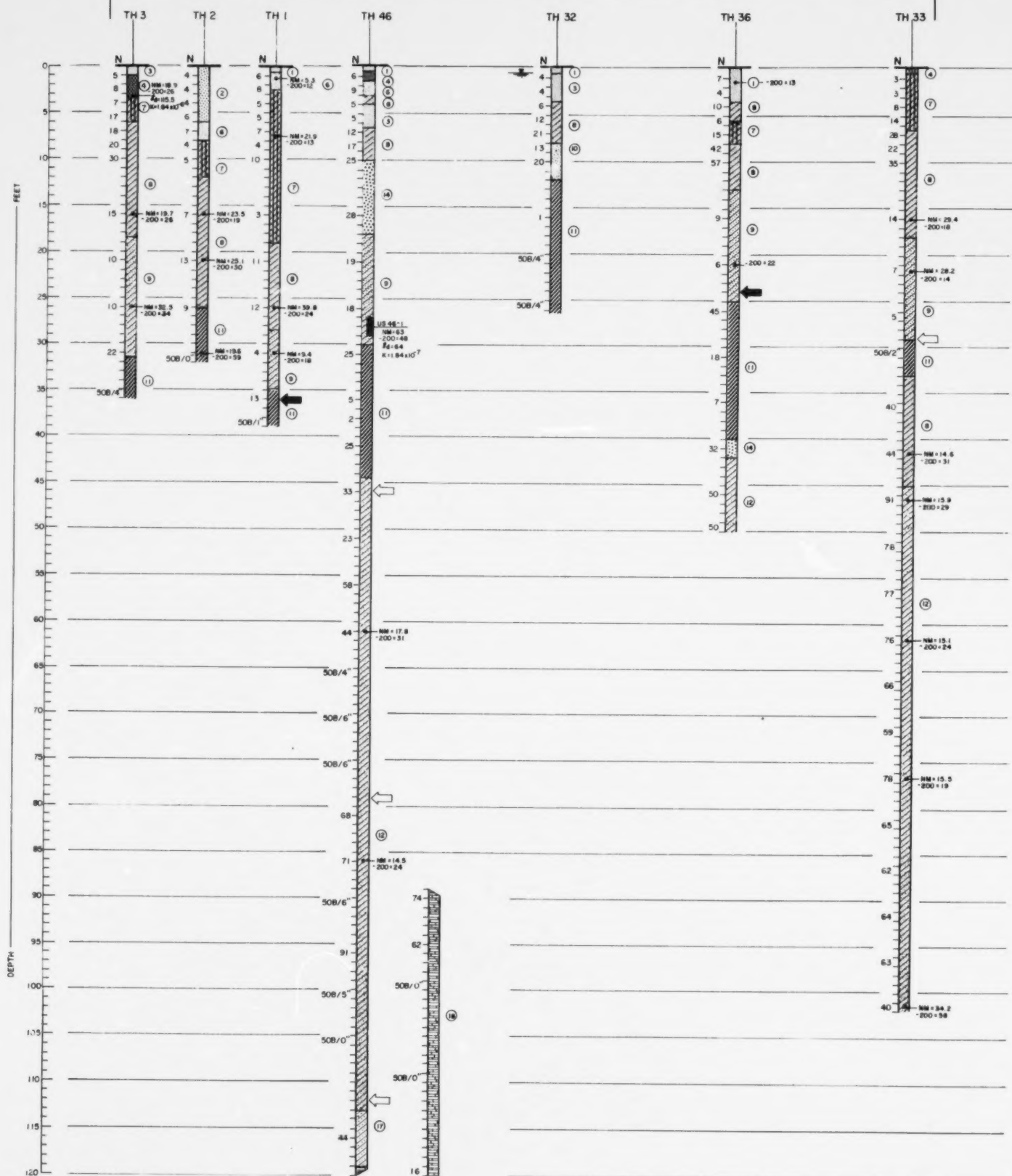
I. COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

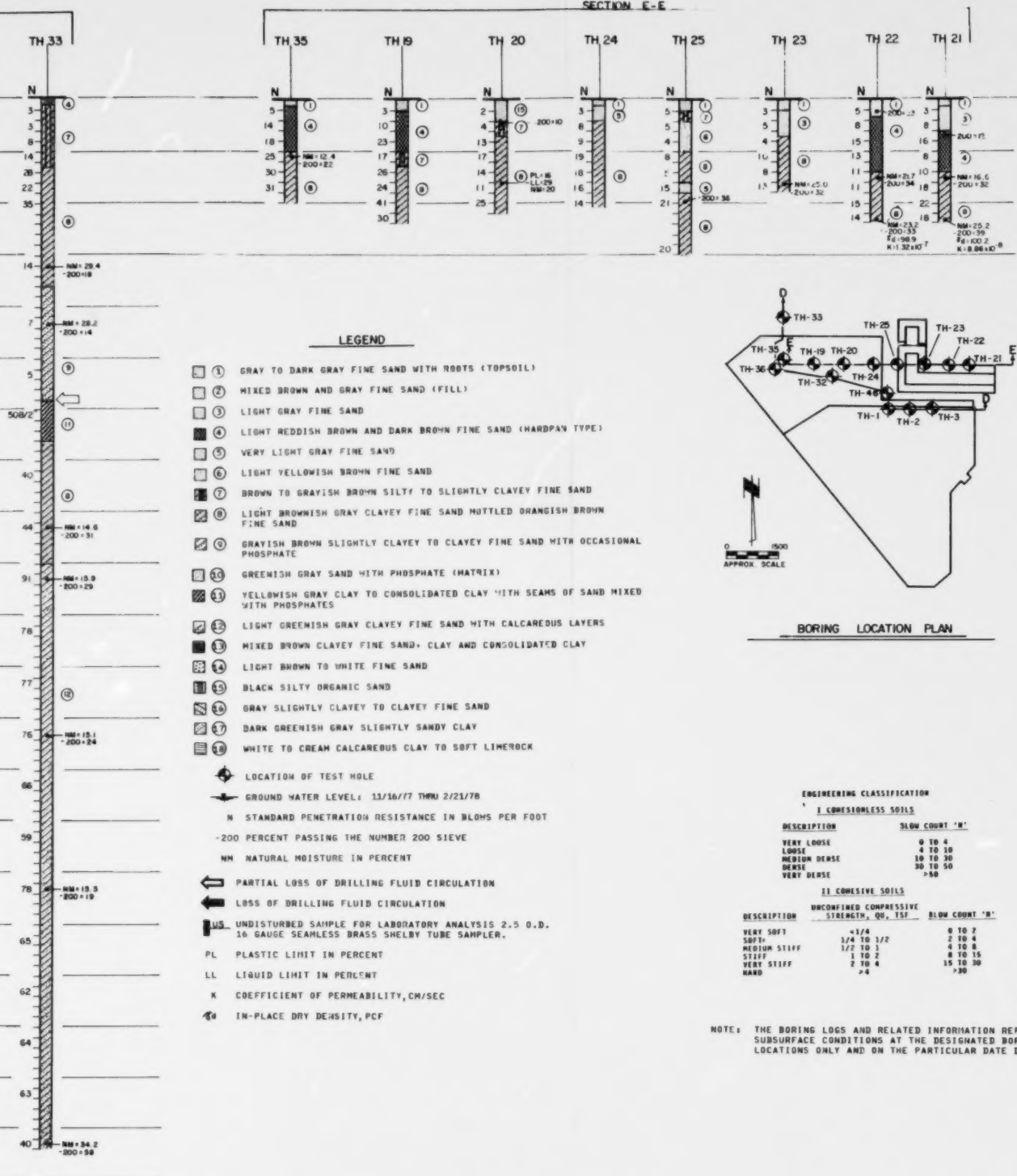
II. COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, q_u , TSF	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

SECTION D-D

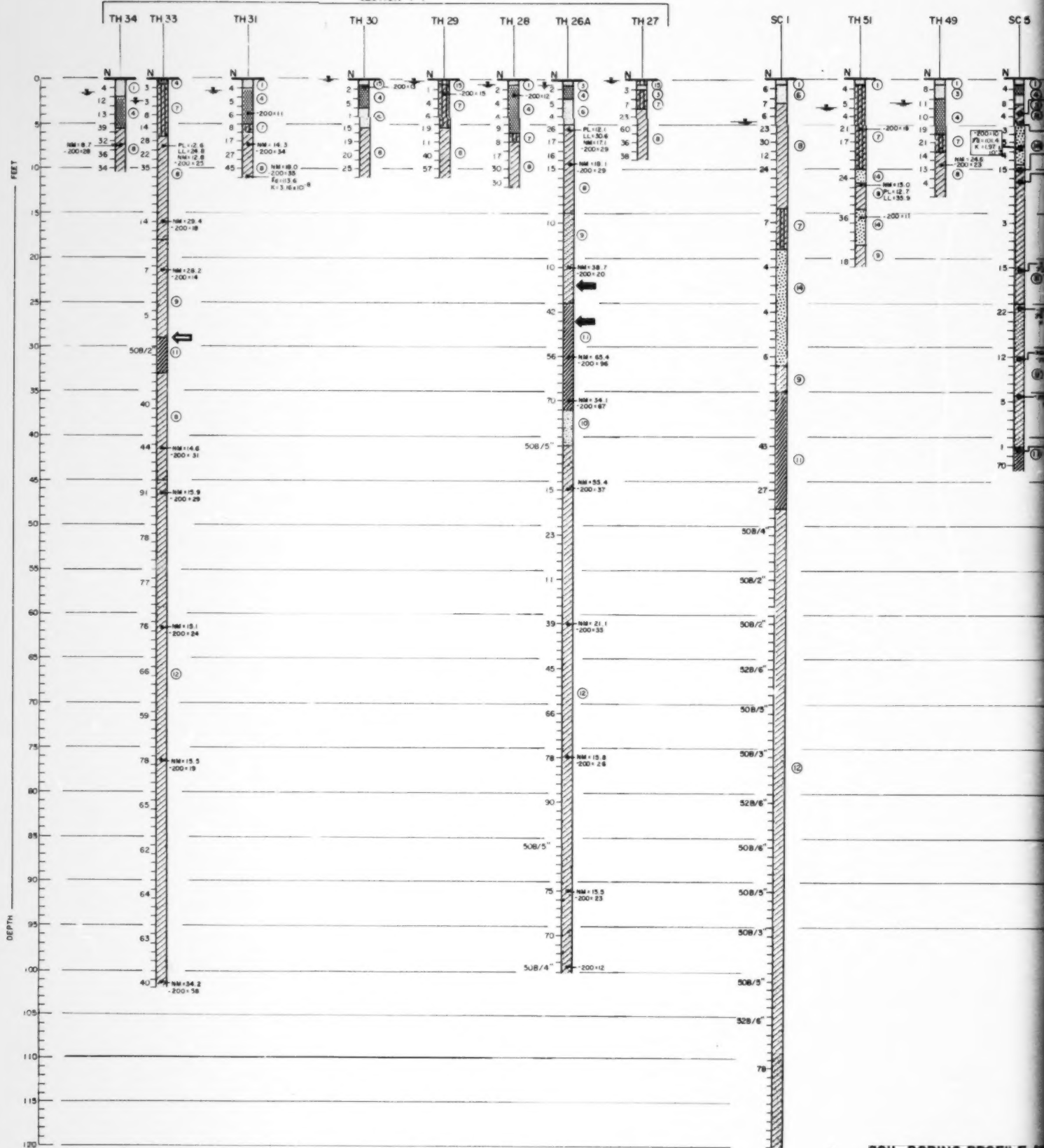


SOIL BORING PROFILE (SECTION D-D)
SWIFT CREEK CHEMICAL COMPANY

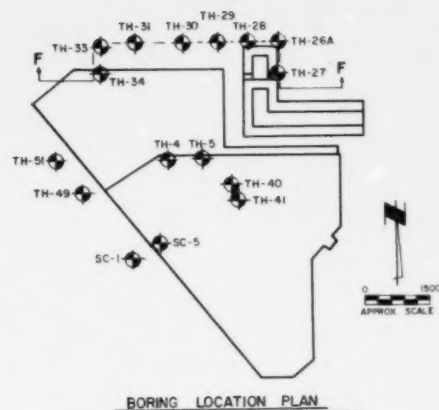
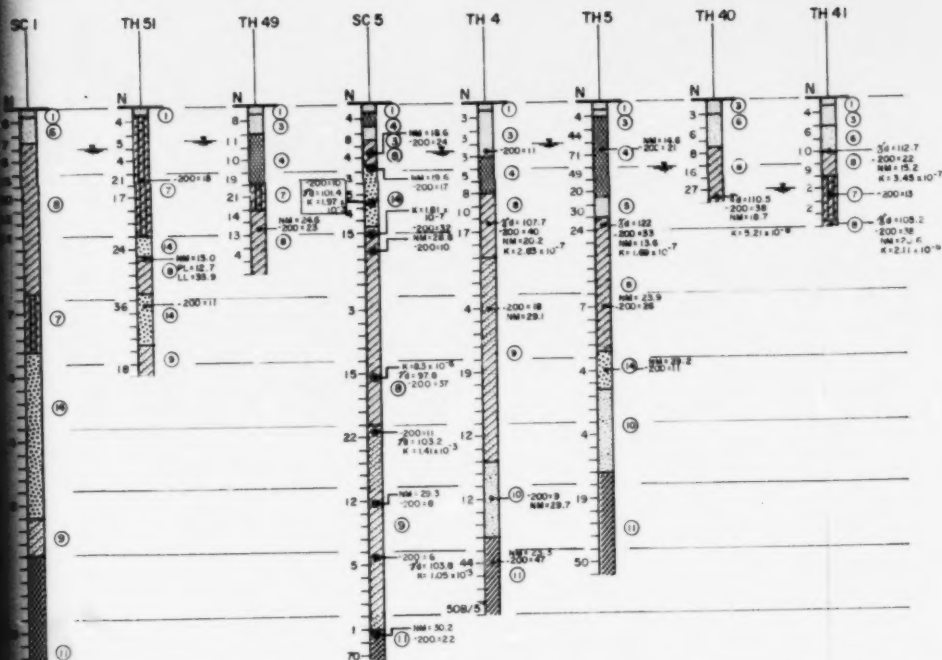


SOIL BORING PROFILE (SECTIONS D & E)
SWIFT CREEK CHEMICAL COMPLEX

SECTION F-F



SOIL BORING PROFILE (M)
SWIFT CREEK CHEMICAL



LEGEND

- 1 GRAY TO DARK GRAY FINE SAND WITH ROOTS (TOPSOIL)
- 2 MIXED BROWN AND GRAY FINE SAND (FELLY)
- 3 LIGHT GRAY FINE SAND
- 4 LIGHT REDDISH BROWN AND DARK BROWN FINE SAND (HARDPAN TYPE)
- 5 VERY LIGHT GRAY FINE SAND
- 6 LIGHT YELLOWISH BROWN FINE SAND
- 7 BROWN TO GRAYISH BROWN SILTY TO SLIGHTLY CLAYEY FINE SAND
- 8 LIGHT BROWNISH GRAY CLAYEY FINE SAND (MOTTLED BROWNISH BROWN FINE SAND)
- 9 GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND WITH OCCASIONAL PHOSPHATE
- 10 GREENISH GRAY SAND WITH PHOSPHATE (MOTTLED)
- 11 YELLOWISH GRAY CLAY TO CONSOLIDATED CLAY WITH SANDS OF SAND MIXED WITH PHOSPHATES
- 12 LIGHT GREENISH GRAY CLAYEY FINE SAND WITH CALCAREOUS LAYERS
- 13 MIXED BROWN CLAYEY FINE SANDS, CLAY AND CONSOLIDATED CLAY
- 14 LIGHT BROWN TO WHITE FINE SAND
- 15 BLACK SILTY ORGANIC SAND
- 16 GRAY SLIGHTLY CLAYEY TO CLAYEY FINE SAND
- 17 DARK GREENISH GRAY SLIGHTLY SANDY CLAY
- 18 WHITE TO CREAMY CALCAREOUS CLAY TO SOFT LIMEROCK
- LOCATION OF TEST HOLE
- GROUND WATER LEVEL: 52/54/77 - 2/21/78
- STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
- PERCENT PASSING THE NUMBER 200 SIEVE
- NATURAL MOISTURE IN PERCENT
- PARTIAL LOSS OF DRILLING FLUID CIRCULATION
- LOSS OF DRILLING FLUID CIRCULATION
- UNDISTURBED SAMPLE FOR LABORATORY ANALYSIS 2.5 IN. I.D. 24 GAUGE TEAMLESS BRASS SHELBY TUBE SAMPLER.
- PL PLASTIC LIMIT IN PERCENT
- LI LIQUID LIMIT IN PERCENT
- K COEFFICIENT OF PERMEABILITY, CM/SEC
- γ_e IN-PLACE DRY DENSITY, PCF

NOTE: THE BORING LOGS AND RELATED INFORMATION REPRESENT THE SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION ONLY AND ON THE DATE DRILLED.

SOIL BORING PROFILE (SECTION F)
SWIFT CREEK CHEMICAL COMPLEX

ENGINEERING CLASSIFICATION		
I. NONCOHESIVE SOILS		
DESCRIPTION		BLOW COUNT "N"
VERY LOOSE		0 TO 4
LOOSE		4 TO 10
MEDIUM DENSE		10 TO 30
DENSE		30 TO 50
VERY DENSE		>50
II. COHESIVE SOILS		
DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSP	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 7
STIFF	1 TO 2	7 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

APPENDIX A2.4.2

GEOMORPHOLOGIC FEATURES:
SINKHOLES AND DEPRESSIONS

A2.4.2.1 Cavern Development

The Florida Peninsula has alternately emerged above and been submerged below sea level many times during its geologic history. During times of submergence, deposits of calcium and magnesium carbonate accumulated in deeper water far from shore by both chemical precipitation from sea water and sedimentation of the remains of marine organisms. Closer to shore, sediments brought to the sea from an adjacent land mass by ancient rivers were deposited. Near the shoreline, these deposits were predominantly sand, which accumulated with coral and shells as beach deposits. Further from shore and in deeper estuaries, the sediments were predominantly silt and clay.

As the seas receded and the shoreline moved progressively away from the land mass, the sand deposits covered the silt and clay deposits which in turn covered the carbonate deposits. With time, the carbonates consolidated to form limestone and dolomite; clays and silts became mudstone and siltstone, and the sand and shell deposits became sandstones, sandy limestones and coquina.

On the emergent land surface, erosion by water flowing out toward the sea began to remove the sediments and as the base level was lowered and the overlying sediments removed, the carbonate rocks became exposed to weathering. The weathering of carbonate rocks and especially limestone is mainly by solution; i.e., the rock constituents are dissolved before being carried away by flowing water. The solvent is created by rain-water combining with carbon dioxide in the atmosphere to form a weak carbonic acid.

If the soluble rocks are dense and have a low permeability, runoff from rain will flow across the surface of the rock until it encounters a joint or fracture in the rock where it can enter the rock formation. The water will follow the joint pattern down to an impervious bed or to the water table, and then flow downgradient through other joints and bedding planes to an outcrop of the rock in a nearby valley or other low area where it will exit as a spring. Because of the solubility of the rock, its surface is lowered and the joints, the bedding planes and especially their intersections are enlarged to form horizontal cavities and caverns in the rock mass. As the sea level continues to decrease, the water level in the rock is lowered and the caverns form at a deeper

level. Several levels of caverns connected by vertical tubes may develop in this manner. The solutioning is most active at or near the water table, when the water is still acidic. After the water has been in contact with the limestone for some time, it becomes saturated with the dissolved substance and is no longer capable of significant dissolution.

Upon resubmergence, the soluble rock, including its cavities, and the other sedimentary formations are buried under new sediment, and the geologic processes begin again. In all, a total of 12 erosion intervals with intervening depositional periods covering the entire Floridan Peninsula have been identified in geologic formations deposited during the last 260 million years.

A2.4.2.2 Review of Sinkhole Phenomena

There are three distinct types of sinkholes which have developed in Florida. The first type is the classical collapse sink (Figure A2.4-6), which is generally steep-sided and rocky. It occurs when a cavity can no longer support the weight of the overlying soil and rock. This type of sink generally occurs when the limestone is at or near the surface and solution weathering is still very active. It is unlikely that cavities in ancient rocks at great depth below the surface, which have undergone much more intensive solution weathering in the past, are large enough to cause a deep-seated roof collapse. Any cavity which is large enough to have caused a roof collapse would have done so when it was closer to the surface and the beam action or arching effects of the overlying formation was not as great as it is today.

The second type of sink, which is more common though not as dramatic as the collapse sink, is called a doline or solution sink (Figure A2.4-7). There is no physical disturbance of the soluble rock beneath a doline. Subsidence of the overlying soil occurs due to gradual lowering of the rock surface and/or the gradual dissolution or leaching of calcium carbonate from the calcareous soil and rock which exists between the ground surface and the underlying aquifers. (The Florida Geological Survey estimates that this type of subsidence occurs at the rate of one foot every five to six thousand years.) Because the water flows radially to the intersection of vertical joints where the water enters the rock mass, the surface expression of the rock lowering or the leaching of the soluble soil constituents is a shallow depression located over the intersection of the joints.

The third type of sinkhole and probably the most common type of sink occurring in Florida is the erosion sink (Figure A2.4-8). Erosion sinks most frequently occur in an environment with the following characteristics:

- (1) Limestones overlain by relatively pervious unconsolidated sediments; e.g., sandy soils.
- (2) Cavity systems present in the limestone.
- (3) A water table higher than the piezometric surface.
- (4) A breach of the limestone into the cavernous zone creating a point of high recharge to the artesian aquifer.

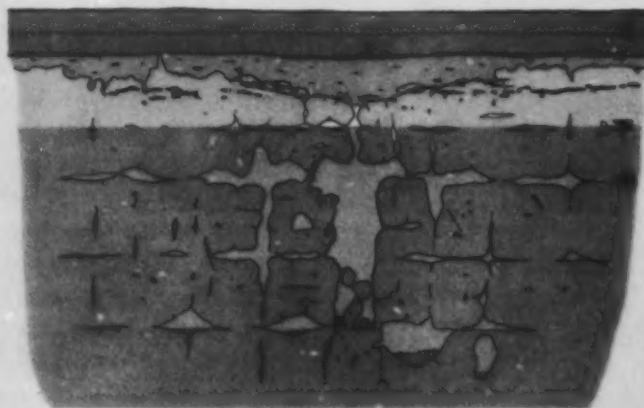
Under these circumstances, water moving down into the limestone may take large amounts of sediment into the cavernous system creating a void in the overlying sediment. When the void in the overlying sediment reaches the size where the roof is no longer stable, the overburden suddenly collapses. In many cases the overburden is visible after the collapse, but some sinks of this type have occurred in which even the collapsed overburden disappeared into the cavity system. In other cases, the sudden subsidence of the ground surface is only six inches to one foot deep.

**COLLAPSE
SINK**

①



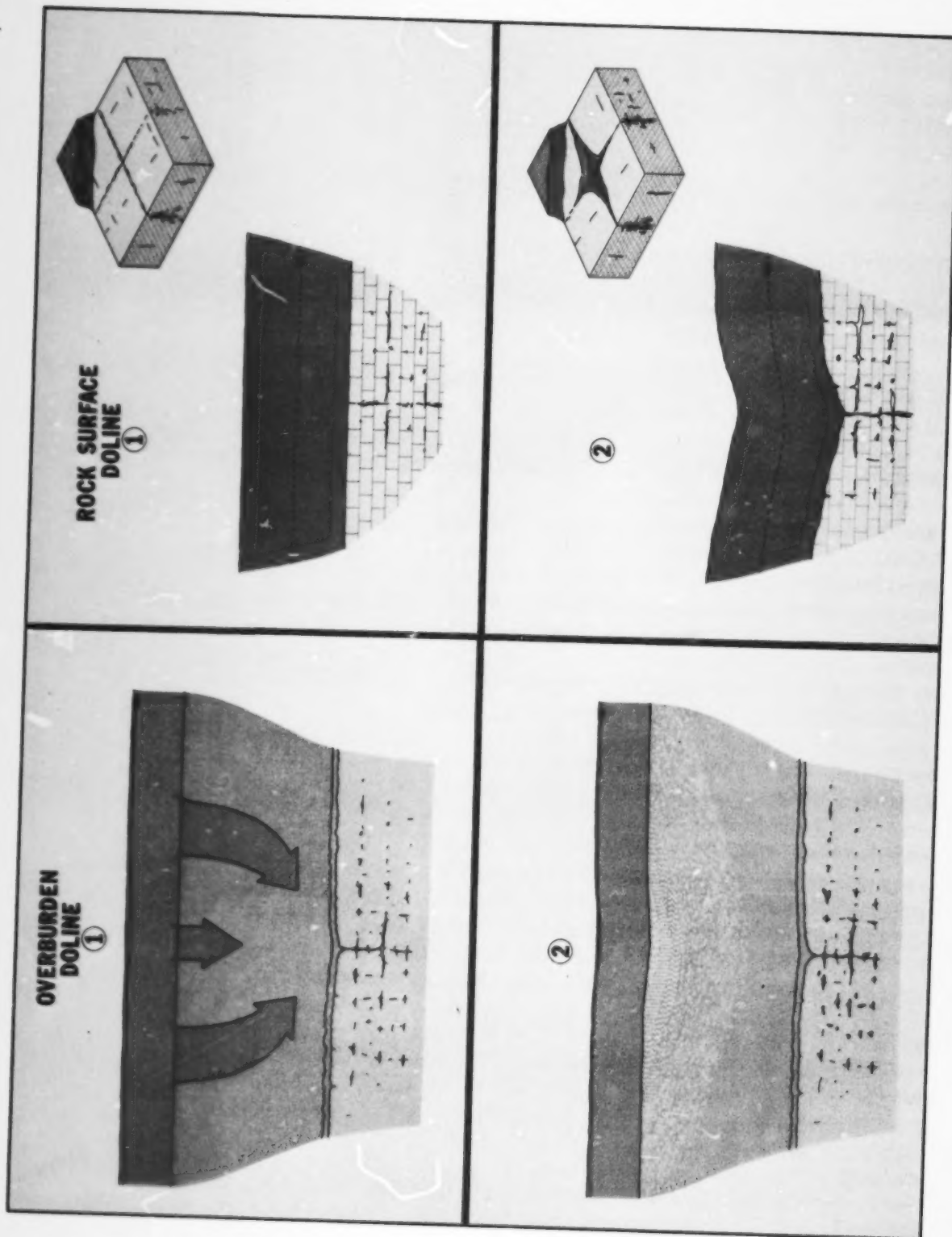
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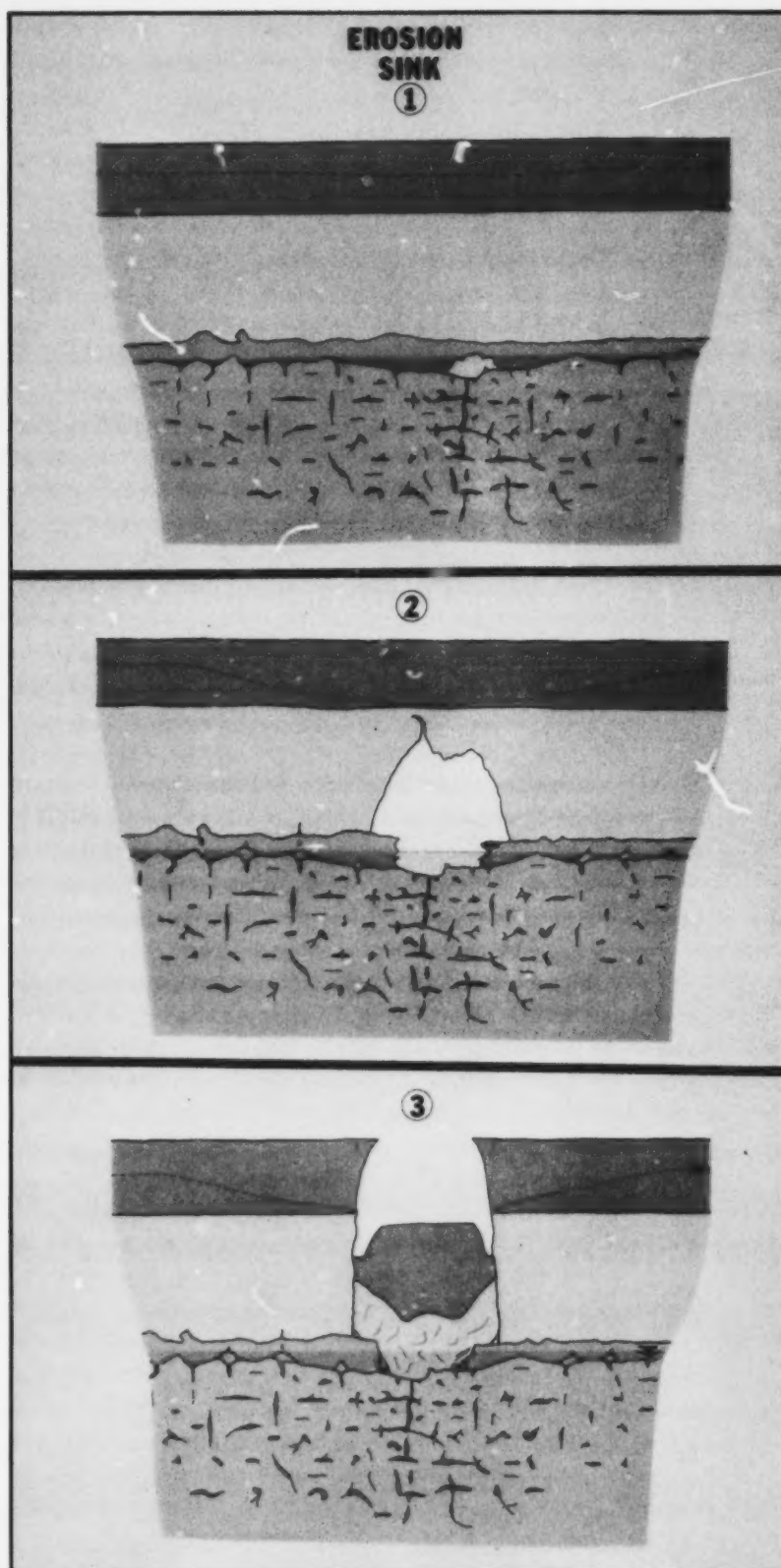
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COLLAPSE SINK



DOLINE



EROSION SINK

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2.5 SOILS

2.5.1 GENERAL DESCRIPTION

The surface soils of Hamilton County range from sloping well-drained sands to nearly level very poorly drained sandy soils. The more well-drained soils generally occur west of the Alapaha River and southwest of Jasper. Slightly sloping to nearly level somewhat poorly to very poorly drained soils dominate the eastern portion of Hamilton County, where the site is located.

Figure 2.5-1 shows the major soil associations of the Swift Creek Drainage Basin. A soil association represents a group of several soils, including at least one major soil series, that form a distinctive pattern and exhibit similar drainage characteristics. Each soil association delineation represents the prevalent soil condition and may contain individual localized soils which have ratings different from the general rating of the association.

The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) has not surveyed Hamilton County; therefore, detailed soil

series and mapping unit descriptions are not available.

The soil association map prepared by the Florida Department of Administration (reproduced in Figure 2.5-1) indicates that the soils at the proposed Occidental Swift Creek Chemical Complex belong to the Leon-Mascotte-Rutlege Association. The major soil series comprising the association are the Leon, Mascotte and Rutlege Series which account for 30, 30 and 20 percent of the association, respectively.

The Leon Series consists of nearly level to gently sloping soils. They have a thin surface layer of grey to yellowish dark grey fine sand, overlying a light grey to white fine sand. At a depth of less than 30 inches, a dark organic pan layer, weakly to strongly cemented, is encountered. Under the organic pan, a light-colored fine sand or a light-colored clayey sand occurs. The Rutlege Series is characterized by a very dark grey to black fine surficial sand layer which merges into an underlying grey to dark grey fine sand. A layer of grey clayey sand mottled with brown, reddish-brown or yellowish-brown clayey sands is found at a depth of 36 to 72 inches. The Mascotte Series has an organic pan similar to the Leon Series and a loamy subsoil similar to the Rutlege Series. The Mascotte Series is described as having a thin surface layer of very dark grey fine sand overlying a grey fine sand. A

dark reddish-brown to dark brown fine sand, weakly cemented, occurs at a typical depth of 16 inches, and is 12 inches thick. Underlying the organic pan is a 6-inch layer of dark brown fine sand. The subsoil is a reddish-yellow and yellowish-brown mottled sandy loam.

According to the Florida Department of Administration, the Leon-Mascotte-Rutlege Association is generally characterized by nearly level poorly drained sandy soils with weakly cemented sandy subsoil; poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil; and very poorly drained soils sandy throughout. Table 2.5-1 presents a brief description of the soils within the other associations found in the Swift Creek Drainage Basin.

A cooperative survey, "Northeast Gulf River Basins, Florida, Georgia, and Alabama," prepared by the USDA in conjunction with several other agencies, contains a small scale general soil map which places the soils of the eastern half of Hamilton County in the Mascotte-Alapaha-Pelham Association. This association is described as consisting of nearly level, poorly drained soils that have thick, loose sandy soil layers overlying a weakly cemented sandy layer and loamy subsoil.

The Standard Penetration Test borings performed at the Occidental site

by Ardaman & Associates, Inc., generally encountered a thin grey to dark grey fine sand (topsoil) underlain by a light grey to light yellowish-brown fine sand. A light reddish-brown to dark brown fine sand (organic pan type), occasionally cemented, was found beneath the surficial sands in approximately 50 percent of the borings. A medium dense grey clayey sand to sandy clay layer mottled with reddish-brown to yellowish-brown soils generally occurs at a depth of 6 to 15 feet below grade. This layer has a typical thickness ranging from 8 to 15 feet. It separates the surficial sand from the phosphate matrix. The phosphate matrix consists of light brown to white fine sand, greenish-grey fine sand to greyish-brown slightly clayey to clayey fine sand with phosphates. A yellow-grey calcareous layer of consolidated clay typically occurs at a depth of approximately 40 feet. A generalized isometric projection of the soils through the site is presented in Figure 2.5-2.

2.5.2 AGRICULTURAL USES

The USDA Soil Conservation Service divides soils into 8 classifications of suitability for cropland and pastureland. These range from Capability Class I, which has few limitations for agricultural purposes, to Capability Class VIII, which is unsuitable for commercial plants. Table

2.5-2 presents brief descriptions of the capability classes.

Soil capability classes are divided into subclasses based on their dominant limitation. The three kinds of limitations recognized at the subclass level are erosion (e), wetness or poor drainage (w), and root zone limiting factors as shallow, droughty, or stony soils (s).

The major soil series composing the Leon-Mascotte-Rutlege Association have capability units ranging from IIIw to IVw. Poor drainage and high water table limit the intended use. The Florida Department of Administration rates the Leon-Mascotte-Rutlege Association as possessing a low potential for crop production, but having a high potential for improved pasture with proper water management. Its capability for pine woodlands ranges from low to moderate. On-site, these soils have traditionally been used for pine timber or pulpwood production. The Mascotte-Alapaha-Pelham Association is poorly drained and is considered to have a moderate degree of limitations for crop production.

2.5.3 ENGINEERING USES

Some of the characteristics which limit a soil's use for agricultural

purposes also affect its capability for foundation support, its capacity to absorb septic tank effluent, for example, or its potential to serve other engineering uses. Some of these more important characteristics are wetness, flood hazard, texture and consistency, depth to rock, permeability, load bearing capacity, shrink-swell potential, slope, and erodibility.

Soils are grouped by the United States Department of Agriculture Soil Conservation Service into three broad classifications based on their degrees of hazard for non-agricultural uses: slight, moderate, and severe. Because of the high water table and poor drainage characteristics of the Leon-Mascotte-Rutlege Association, it is generally rated as "severe" for non-agricultural uses by the Florida Department of Administration. The high water table and loamy subsoil prohibit the absorption of septic tank effluents. Wetness and the potential for flooding also hamper construction activity and decrease the allowable bearing pressure for shallow foundations. The Mascotte-Alapaha-Pelham Association is also considered by the United States Department of Agriculture to have "severe" hazards for community development.

2.5.3.1 Runoff Potential

The United States Department of Agriculture Soil Conservation Service classifies soils into four hydrologic soil groups, A through D, according to the runoff potential under similar stream and cover conditions. The groups are used primarily in watershed management planning to estimate runoff from rainfall. Dual hydrologic groups are given for wet soils rated D (high runoff potential) in their natural condition that can be drained to lower levels of runoff potential. Table 2.5-3 describes the four hydrologic group designations and shows the hydrologic grouping of the major soil series at the site. It also describes the surface soil characteristics of the Leon-Mascotte-Rutledge Association.

Because of the low degree of topographic relief and the relatively low permeability of the organic pan and/or the clayey sand which is generally present near the surface through most of the site, the surface sands tend to saturate during periods of heavy rainfall. A "perched" groundwater table, therefore, occurs at or near the surface throughout much of the summer. Surficial groundwater flow will occur horizontally as base flow towards local relief points in streams. Relief at the site is very low and hence base flow is not very significant in the site area.

2.5.3.2 Foundation for Buildings

The presumptive bearing capacity of the surficial sands is a function of the size of the footing, depth of embedment, location of groundwater table and potential for flooding. Accordingly, in the absence of definitive location and definitive usage conditions, a range rather than a specific bearing value may be assigned. For the general condition of 24-inch minimum width footing embedded a minimum of 18 inches, a presumptive bearing value range from about 2000 psf to 4000 psf may generally be assigned, depending upon the amount of compaction used. These values should be considered as indicators only and should not be considered as design bearing values without further investigation, in accordance with standard foundation engineering practice. A rating of slight has, therefore, been assigned for the site soils for their use as foundations for buildings. The organic soils, where present, have severe limitations for supporting foundations, but if the thin surficial layer, where it occurs, and any muck or peat is excavated and replaced, the substrata is adequately capable of supporting foundations with the range of bearing values given above.

2.5.3.3 Reservoir Embankment Suitability

The use of the various horizons of the surficial soils at the site for pond embankment construction is restricted by their engineering properties to certain sections of the embankment cross section. A Soil Conservation Service rating of "slight, moderate, or severe," is inappropriate without further clarification. Although a soil's suitability for use in a homogeneous embankment may be considered severe, its use in a zoned embankment would be completely acceptable. Construction control and embankment design with particular attention paid to seepage control through the embankment are required for acceptable pond embankment performance. A rating of "severe" can be automatically assigned to organic surface soils, where present, due to the excess humus, high compressibility and low shear strength. However, the substrata at these locations are suitable for construction of a zoned embankment once the organic soils have been excavated.

2.5.4 EROSION POTENTIAL

The erosion potential of a soil depends upon its ability to resist the erosive forces of rainfall and runoff. Once natural vegetation is

removed, the quantity of erosion depends only on the quantity and intensity of the rainfall, the length and steepness of the slope of the unprotected ground surface, the runoff flow velocities and the erodibility of the soil.

With all other factors being equal, it is possible to rank the erodibility of different soils based solely on soil properties. The soil properties which have the largest effect on erodibility are the percentage of silt and very fine sand particles (0.002 to 0.10mm) which are easily eroded, the percentage of sand particles (0.1 to 2.0mm) which are less susceptible to erosion, the percentage of organic matter and cohesive soils which restrict erosion, the soil structure, and the permeability of the soil. These properties have been combined by Wischmeier and Meyer (1973) into a single parameter termed the Soil Erodibility Factor, K, which is normally expressed in tons per acre per rainfall unit for a 9 percent slope, 72.6 feet long, on which there is no vegetation. Values of K for most of the surficial soils on the subject property range from 0.07 to 0.20 and average about 0.15.

These standard values have been modified to reflect the actual slope of the particular soil type and the modified average values do not exceed 0.03. It should be noted that, for the majority of soils on which the

studies by Wischmeier and Meyer were made, the values of K ranged from 0.03 to 0.69. All of the values calculated for the site soils are at the low end of this range, indicating that the site soils have a low erosion potential even when stripped of vegetation because of the soil properties and the flatness of the existing slopes, the latter resulting in low flow velocities.

2.5.5 POST MINING SOIL TYPES

Post mining conditions have been outlined in Sections 2.3.3 and 2.4.3.3.

Mining and subsequent reclamation will alter the natural distribution of soils resulting in a segregation of the natural soils into uniform and looser components, with sands in the tailing disposal areas and clays in the settling-storage areas that are ultimately reclaimed.

Reworked overburden will be present in other locations which have been mined and reclaimed without being used as mining waste storage areas and in reclaimed lakes. Where the overburden is re-deposited, the material becomes poorly sorted, more heterogeneous, less stratified, and less dense than prior to mining.

TABLE 2.5-1

SOIL ASSOCIATIONS OF THE SWIFT CREEK DRAINAGE BASIN

<u>Soil Association</u>	<u>Description</u>
Arredondo, var.-Alaga-Kenney	Nearly level to sloping well-drained soils with very thick sandy layers over loamy subsoil and somewhat excessively drained soils, sandy throughout.
Chiptley-Albany-Plummer	Nearly level to gently sloping moderately well-drained soils, sandy throughout, and somewhat poorly and poorly drained soils with very thick sandy layers over loamy subsoil.
Leon-Mascotte-Rutlege	Nearly level poorly drained sandy soils with weakly cemented sandy subsoil and poorly drained sandy soils with a weakly cemented sandy subsoil layer underlain by loamy subsoil and very poorly drained soils, sandy throughout.
Brighton-Dorovan	Nearly level very poorly drained organic soils underlain by sand.
Fresh Water Swamp	Nearly level very poorly drained soils subject to prolonged flooding.

TABLE 2.5-2

AGRICULTURAL SOIL CAPABILITY CLASSES

Class I -	Soils have few limitations that restrict their use.
Class II -	Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
Class III -	Soils have severe limitations that reduce the choice of plants, require special conservation practice, or both.
Class IV -	Soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
Class V -	Soils are not likely to erode, but have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture, woodland, or wildlife.
Class VI -	Soils have severe limitations that make them generally unsuited for cultivation and that limit their use largely to pasture, woodland, or wildlife.
Class VII -	Soils have very severe limitations that make them unsuited for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.
Class VIII -	Soils and land forms have limitations that preclude their use for commercial plants and that restrict their use to recreation, wildlife, water supply, or aesthetic purposes.

TABLE 2.5-3

SURFACE SOIL CHARACTERISTICS
LEON-MASCOTTE-RUTLEGE ASSOCIATION

Component Soil Series	% of Association	USDA Texture*	Description Color	Depth (in.)	Unified Soil Classification	Permeability in./hr.	Shrink-Swell Potential	Depth To First Rock Layer (ft)
Leon	30	FS	White to Grey	0-24	SP,SP-SM	10->20	Low	>30
		FS	Very Dark Brown to Black	24-30	SP-SM,SM	0.8-2.5	Low	
		FS	Brown	30-60	SP-SM	10->20	Low	
Mascotte	30	FS,S	Grey	0-16	SP-SM	6-20	Very Low	>30
		FS,S	Dark Reddish-Brown to Dark Brown	16-28	SP-SM,SM	0.6-2	Very Low	
		FS,S	Pale Brown	28-34	SP-SM	6-20	Very Low	
		SCL,SL	Grey and Light Grey	34-60	SC,SM-SC	0.6-2	Low	
Rutlege	20	FS	Very Dark Grey to Black	0-10	SP-SM,SM	5-10	Low	>30
		FS	Grey to Dark Grey	10-50	SP-SM	10+	Low	
		FSCL,FSL	Grey, Mottled Brown, Reddish-Brown, Yellowish-Brown	50-72	SC-CL	0.8-2.5	Low-Medium	
Others	20							

Component Soil Series	Wet Season Water Table Depth (in.)	Duration (mo.)	Slopes (%)	Hydrologic Group**	Dust Potential	Erosion Potential; Modified Soil Erodability Factor, K	Degree of Limitation As Foundation For Buildings	Reservoir Embankment Suitability
Leon	0-12	3	0-2	A/D	Low to Moderate	Low <0.03	Slight	Good, downstream shell with flat slopes and seepage control.
	0-12	3	0-2	B/D	Low	Low <0.03	Slight	Good, zoned embankments with seepage control.
Mascotte	0-12	3	0-2	A/D	Low	Low <0.03	Slight	Good, zoned embankments with seepage control.
	0-12	3	0-2	A/D	Low	Low <0.03	Slight	Good, zoned embankments with seepage control.
Rutlege	0-2	3	0-2	A/D	Low	Low <0.03	Slight	Good, zoned embankments with seepage control.

*FS = Fine Sand

FSL = Fine Sandy Loam

FSCL = Fine Sandy Clayey Loam

S = Sand

SL = Sandy Loam

SCL = Sandy Clayey Loam

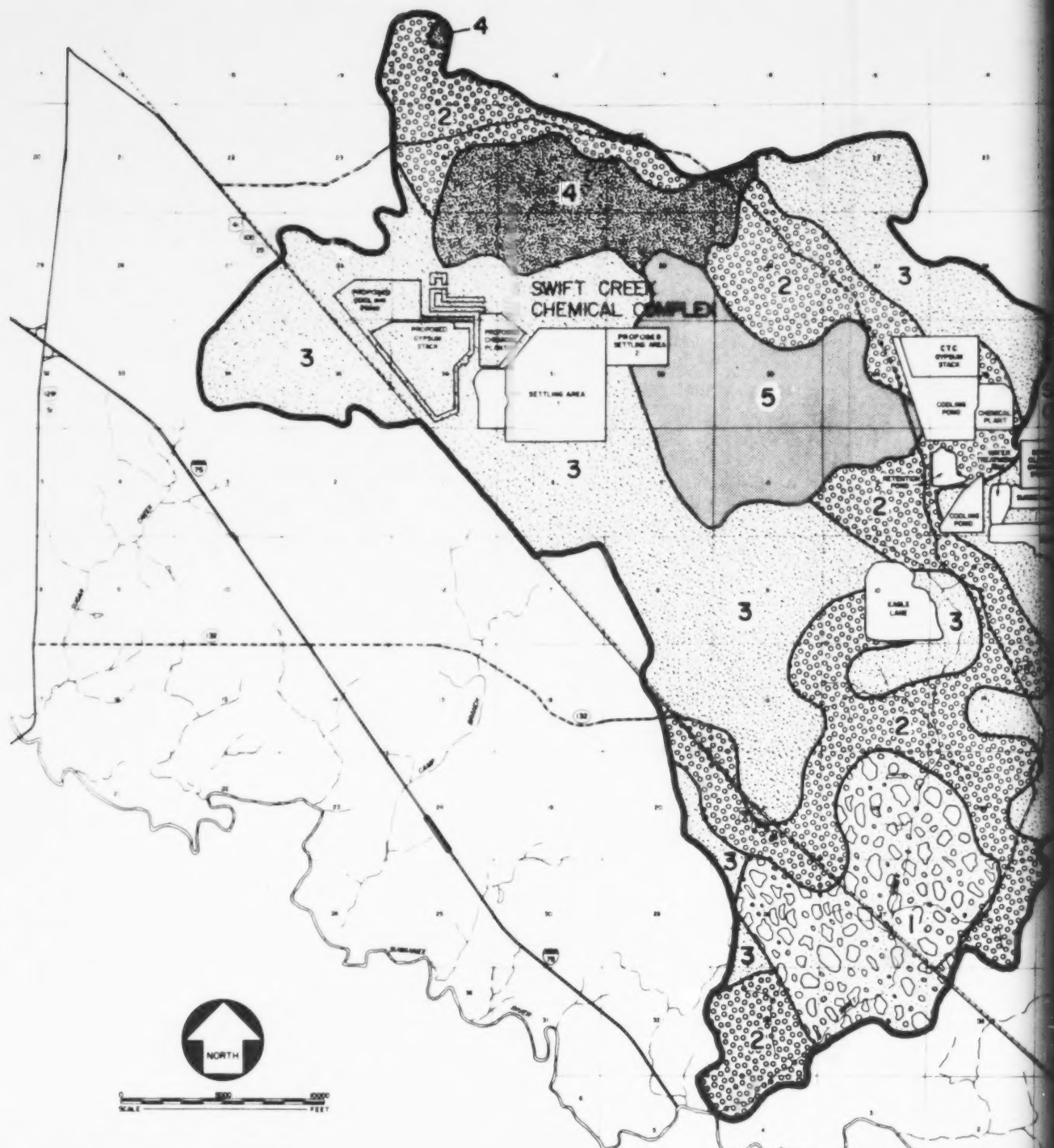
**Hydrologic Group:

A - Low Runoff Potential - Soils that have high infiltration rates even when thoroughly wetted and a high rate of water transmission.

B - Moderately Low Runoff Potential - Soils that have moderate infiltration rates when thoroughly wetted and a moderate rate of water transmission.

C - Moderately High Runoff Potential - Soils that have slow infiltration rates when thoroughly wetted and a slow rate of water transmission.

D - High Runoff Potential - Soils having very slow infiltration rates when thoroughly wetted and a very slow rate of water transmission.



OCCIDENTAL CHEMICAL COMPANY
 SWIFT CREEK CHEMICAL COMPLEX
 HAMILTON COUNTY, FLORIDA

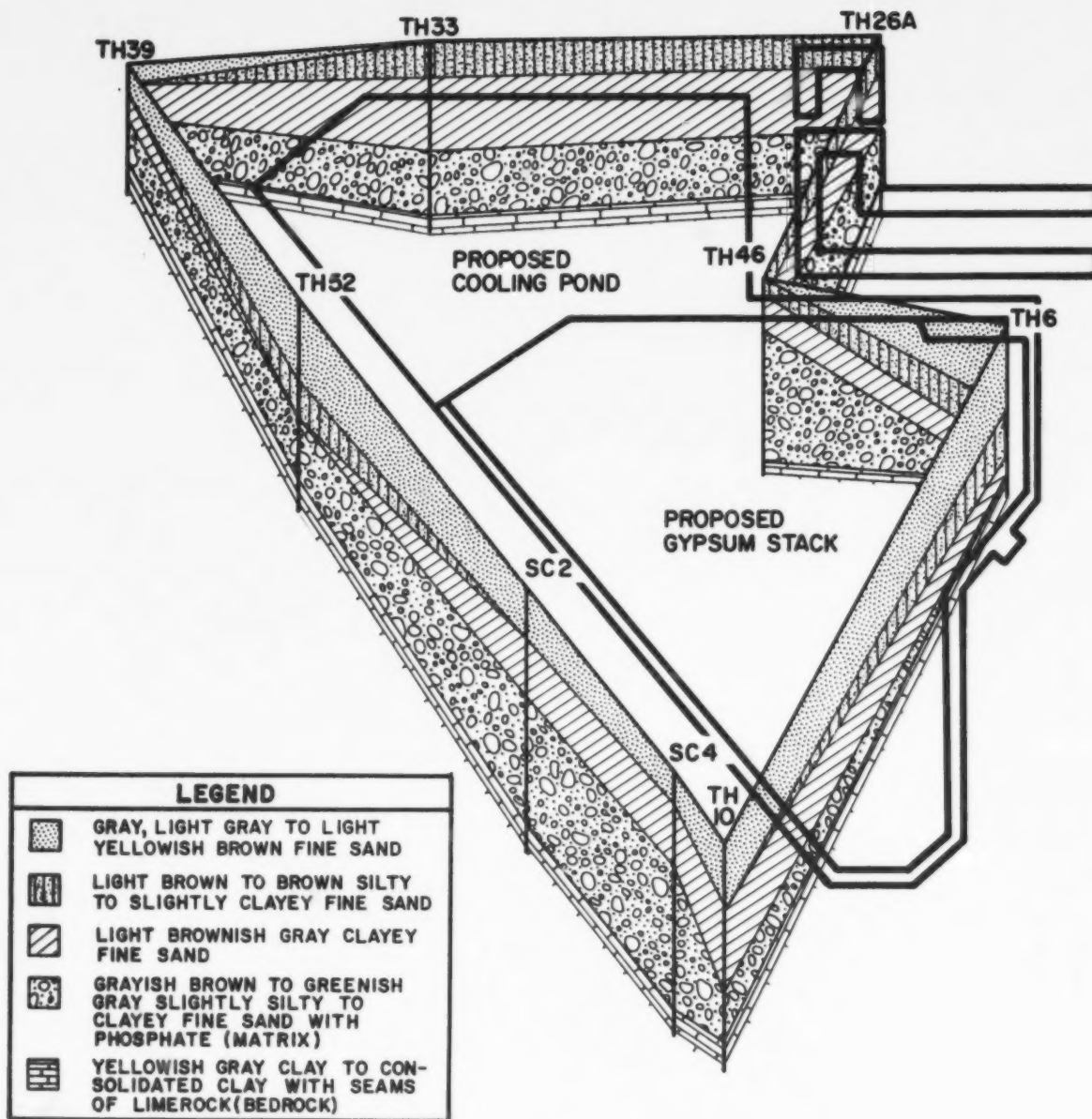
LEGEND

SYMBOL	SOIL ASSOCIATION	DESCRIPTION
	ARREDONDO, var. ALAGA-KENNEY ASSOCIATION	WELL DRAINED SOILS NOT SUBJECT TO FLOODING
	CHIPLEY-ALBANY-PLUMMER ASSOCIATION	MODERATELY WELL TO POORLY DRAINED SOILS NOT SUBJECT TO FLOODING
3	LEON-MASCOTTE-RUTLEGE ASSOCIATION	
4	BRIGHTON-DOROVAN ASSOCIATION	POORLY AND VERY POORLY DRAINED SOILS SUBJECT TO FLOODING
5	FRESH WATER SWAMP ASSOCIATION	

SOIL ASSO



SOIL ASSOCIATION MAP



GENERALIZED SUBSURFACE PROJECTION THROUGH
PROPOSED SWIFT CREEK CHEMICAL COMPLEX SITE

LIST OF REFERENCES
(Section 2.5)

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2.6 HYDROLOGY

2.6.1 HYDROLOGIC CYCLE

Specific data on various phases of the hydrologic cycle are essential for establishing background conditions and assessing the impacts of the proposed facility. The main water input is from precipitation supplemented by surface water and groundwater inflow. Outputs from the system consist of open-water evaporation, evapo-transpiration from soil and vegetation, surface runoff, base flow into streams, recharge to the underlying aquifers and groundwater outflow from the aquifer system.

The proposed Occidental Chemical Company Swift Creek Chemical Complex is located within Hamilton County in northern Florida, which experiences a humid subtropical climatological regime. Section 2.1 summarized relevant climatological and meteorological data for the site.

The long-term average precipitation in the site vicinity is approximately 54 inches per year. Yearly rainfall variations can, however, be quite significant, as exhibited by a range varying from approximately 33 inches in 1968 to more than 75 inches in 1959. Since June 1965, Occi-

dental Chemical Company has maintained and monitored a rain gauge at their Suwannee River plant site. Their records indicate an eleven-year average of approximately 46 inches and an apparent average deficit in precipitation of approximately 8 inches per year compared to the long-term average records in the area.

The volume of precipitation is unevenly distributed over the year. Approximately 40 to 50 percent of the yearly rainfall is attributed to tropical disturbances during the wet season (June through September) that result in large volumes of localized rain in the form of thunderstorms and intense afternoon showers. Rain in the remaining 8 months of the year, attributed generally to the passage of frontal systems, comprises the remaining percentage of the annual precipitation. This climatological regime generally results in flooding during the relatively short wet season with the occurrence of successive storms that saturate the surficial soils and result in increased runoff volumes. It is also responsible for the likelihood of drought that generally occurs towards the end of the "dry" season.

The average annual lake and open water evaporation in Hamilton County equals approximately 46 inches per year (Visser and Hughes, 1969). Open water evaporation forms part of the total process of evapo-transpiration

which averages approximately 40 inches per year in Hamilton County (Fisk, 1977). The actual rate of evapo-transpiration in the Swift Creek Basin may differ from the above value and is subject to local and yearly variations that depend upon the amount and frequency of rainfall and local differences in climatologic, topographic and geologic factors.

The difference in the long-term average rates of precipitation and evapo-transpiration, equaling approximately 11 to 14 inches per year, consists of surface runoff, water exiting as base flow into creeks and water entering and recharging the underlying aquifers (which amount is controlled by the leakance and head difference across confining beds). Runoff in Hamilton County generally exceeds 10 inches per year (Kenner, 1966) but may be subject to significant local and yearly variations.

2.6.2 SURFACE WATER QUANTITY

The proposed Occidental Chemical Company Swift Creek Chemical Complex lies on the west side of the Swift Creek drainage basin. Swift Creek is a tributary to the Suwannee River, the major river drainage in this section of North Florida. Section 2.3 presented the characteristics of the Swift Creek drainage basin. Figure 2.6-1, which was also described

in Section 2.3, outlines the drainage boundary of Swift Creek and the location of various monitoring and sampling stations. The flow characteristics of both the Suwannee River and Swift Creek are important for environmental considerations.

2.6.2.1 Suwannee River Flows

The Suwannee River has its headwater in Georgia in the Okefenokee Swamp and flows south to White Springs, Florida where it turns west, then winds its way south to the Gulf of Mexico. At White Springs, the river drains 2,430 square miles, with approximately half the drainage area flow originating in Georgia. The flow up to this point is composed almost entirely of swamp drainage. At White Springs, the river starts to pick up large amounts of base flow from numerous limestone springs, and the character of the water, as well as flow conditions, change significantly. Since 1969, the records at White Springs indicate a maximum daily flow of as much as 38,000 cfs, a low flow of about 30 cfs, and an average flow of about 1880 cfs.

2.6.2.1.1 Average Flows of the Suwannee River

The flow of the Suwannee River has been measured by the United States Geological Survey (USGS) at Station 02315500, Suwannee River at White

Springs, Florida, just upstream from the Swift Creek confluence, since 1927. The monthly and yearly average flows and statistics for this station, as developed from a magnetic tape of daily flows obtained from the USGS, are presented in Figure 2.6-2.

Several years of miscellaneous discharge measurements and about 18 months of daily discharge records collected during 1976 and 1977 have been published by the USGS for Station 02315000, Suwannee River at Benton, Florida, upstream from White Springs, and for Station 02315550, Suwannee River at Suwannee Springs, Florida, downstream from White Springs. These short-term daily and partial records are not adequate in themselves to provide any measure of average or seasonal flow parameters for these stations. They do correlate very well, however, with concurrent flows for the station at White Springs. Such correlations allow the full period of record at White Springs to be transferred to these sites with reasonable accuracy. The results of this transfer in simulated monthly and yearly flows are presented in Figure 2.6-3 which depicts the minimum, average and maximum monthly flows as well as deviations from average monthly flows for each of these stations.

Swift Creek drains into the Suwannee River between White Springs and

Suwannee Springs. A record would, therefore, be desirable at the mouth of Swift Creek. Several water quality samples have been collected from the Suwannee River at the mouth of Swift Creek, but in general this sampling did not include the measurement of discharge. Therefore, no accurate transfer relation can be prepared to compute simulated flows at this location. Reasonable figures of the principal long-term streamflow characteristics have been interpolated for this site based on the White Springs and Suwannee Springs information and are presented in Table 2.6-1. Other principal long-term streamflow characteristics for the Suwannee River and its main tributaries are also presented in this table. Swift Creek, the Alapaha River, the Withlacoochee River and the Santa Fe River flows represent approximately 0.5, 8, 19 and 23 percent, respectively, of the Suwannee River flow near Wilcox, Florida.

2.6.2.1.2 Low Flows of the Suwannee River

The minimum 7-day and 30-day low flows for each year of record of the Suwannee River have been analyzed statistically. From this analysis, the mean annual 7-day low flow ($M7,2$)* and the 10-year 7-day low flow ($M7,10$)† and the mean annual and 10-year 30-day low flows ($M30,2$ and $M30,10$) have been obtained and are presented in Table 2.6-1.

*7-day low flow to which flows will recede once every two years.

†7-day low flow to which flows will recede once in ten years.

2.6.2.2 Swift Creek Flows

Runoff in Swift Creek, as in most area streams, varies significantly in response to variations in rainfall. Miscellaneous discharge measurements have been made since 1969 and daily discharge records were collected starting in May, 1976 at the USGS Gauging Station 02315520, Swift Creek at Facil, Florida. These records reflect current mining operations and do not correlate well with records for nearby gauged streams of similar hydrologic characteristics. Similar records for USGS Gauging Station 02314986, Rocky Creek near Belmont, Florida, which are not affected by any development to-date also do not correlate well with records for nearby gauged streams.

The records available to-date on Swift Creek do not provide a measure of long-term streamflow characteristics. Therefore, use was made of correlations of the available data with concurrent records of the difference in the flows recorded at Suwannee River near White Springs, Florida and Suwannee River at Fargo, Georgia, in order to establish long-term natural streamflow characteristics for Swift Creek.

2.6.2.2.1 Natural Average Flows of Swift Creek

Based on the above correlations, the natural average flow of Swift Creek prior to development at the USGS Gauging Station 02315520, Swift Creek at Facil, was estimated at 0.8 cubic feet per second per square mile (cfs per mi^2). The flow is assumed to be distributed in time the same as the difference in flows between the Suwannee River at White Springs, Florida and Fargo, Georgia. Figure 2.6-4 shows the generated monthly and yearly average flows for 43 years based on this estimate. The flows measured and published by the USGS for this site since May 1976 exceed these figures by an amount believed to be equivalent to the flow augmentation caused by current Occidental operations. The actual measured flows are presented in Table 2.6-2 and discussed in Section 2.6.2.2.3.

2.6.2.2.2 Natural Low Flows of Swift Creek

During storms, when precipitation rates exceed the infiltration capacity of the soil, a significant part of streamflow consists of surface runoff. Several hours or days after the rainfall excess has passed, the streamflow includes only base flow which recedes in time as the source of the base flow is depleted. Figure 2.6-5 presents a section and profile which schematically depict the relation of the shallow aquifer

to base flow. Base flow is made up of both the water out of shallow pond storage and out of the shallow groundwater aquifer. Some hydrologists would refer to the groundwater portion only as base flow. Where shallow pond storage is large, as in most upland streams in Hamilton County, it becomes difficult to identify the amount of base flow that can be attributed solely to the groundwater component. Further, when records are affected by development such as on Swift Creek, hydrographic separation into surface-water, base-flow (total) or surface-water-groundwater components is even more difficult. Ordinarily, several years of daily discharge records are required to get a reasonable measure of the percent of total flow originating as base flow from groundwater.

Only 16 months of daily discharge records are available for the USGS gauges on Swift and Rocky Creeks in Hamilton County. Estimates of flows on Rocky Creek, which is not regulated, indicate a very low runoff rate of only 0.44 cfs per mi^2 . This low rate is believed to be caused by very minimal surface drainage from the extremely large part of the basin in upland depressions, and migration of the shallow aquifer groundwater under adjacent basins to the Suwannee River. Of the 0.44 cfs per mi^2 in Rocky Creek, rough computations indicate only 5 to 15 percent is from the shallow aquifer. On Swift Creek, the estimate of 0.8 cfs per mi^2

total runoff is based on indication of more surface drainage from Swift Creek Swamp than from Bee Haven Bay in the Rocky Creek basin, and somewhat higher percentage of groundwater base flow especially from that portion of Swift Creek downstream from the new monitoring gauge SC 7.5 at the railroad bridge (Figure 2.6-1). The higher amount of base flow is related to the deeply incised channel between gauge SC 7.5 and the USGS gauge at Facil. A very rough estimate of the groundwater component would range from 10 to 20 percent of the natural flow of Swift Creek.

The 7-day and 30-day mean annual and 10-year natural low flow parameters for Swift Creek at the USGS Station 02315520, at Facil, can only be roughly estimated with the present development and short period of monitoring as follows:

M7,2	1 - 2	cfs
M7,10	0 - 0.2	cfs
M30,2	2 - 3	cfs
M30,10	0.3 - 0.5	cfs

Note that the lowest daily flow to-date has been recorded as 1.7 cfs on November 12, 1977. Now that Occidental Chemical Company has installed recorders on flumes located in their hydraulic return water ditches and two additional stream gauges have been installed on Swift Creek (Figure

2.6-1), there is hope of better defining the groundwater outflow and low flow parameters in the future.

2.6.2.2.3 Effect of Mining Operations on Swift Creek Flows

The actual measured flows at the USGS gauge, Swift Creek at Facil, summarized in Table 2.6-2, indicate a maximum daily discharge of about 1,200 cfs and a minimum of about 2 cfs. Swift Creek is a partially controlled discharge stream and hence its measured averages do not reflect natural flow conditions. The storm-runoff patterns are not readily apparent from recorded discharge data because the artificial discharges maintain the flow at relatively high levels even during the dry season and occasional curtailment of releases provides misleading reductions in flow.

Under current conditions, the measured flows do not include natural flow that would normally run off from areas occluded from Swift Creek by mining pits, clay settling ponds, gypsum stacks, etc. Swift Creek Mine and Suwannee River Mine and Chemical Complex occlude approximately 9.3 square miles of the original 37.9 square miles of drainage to the USGS gauge 02315520, Swift Creek at Facil. This would amount to a 25% reduction of flow. The actual reduction cannot be this much because

during floods some of the excess runoff within the system is released back into Swift Creek after passing through settling areas. Further, the current reduction of flow is overridden by a release of non-process water much of it derived from the deep aquifer that did not normally contribute to Swift Creek. Non-process water releases also include runoff from rainfall within the confines of the existing chemical and beneficiation plants. Non-process water diverted to Swift Creek when Swift Creek Mine and Suwannee River Mine and Chemical Complex are on-line will average 31.1 cubic feet per second over extended periods.* Since the non-process water is stored and regulated, occasional rates of effluent measured in the past do not identify the long-term effects. New recording devices on releases and the new gauge installed at the NPDES stream monitoring site No. 001 at the Occidental Railroad Spur (monitoring Station SC 7.5) will help measure the effects of mining operations in the future.

The overall effects of occlusion of certain drainage areas and augmentation by non-process water releases appear to provide an average increase of 20 to 25 cfs for conditions existing during the period of data

*The average discharge would be somewhat higher; i.e., about 33 cfs, if the Suwannee River Chemical Plant were to operate for 365 days a year. The figure of 31.1 cfs is based on 310 days operation per year for the plant and 365 days operation of the Swift Creek and Suwannee River Mines (See Section 1.0 and corresponding appendices).

collected for Swift Creek, as presented in Table 2.6-2. This would indicate a long-term average flow of about 50 to 55 cfs for the USGS Gauging Station at Facil for current conditions. At times when the plant had shut down, USGS records showed sudden reductions of flow of up to 40 cfs. This value compares to an estimated average discharge of 33 cfs from all existing operations, the latter figure not including rain runoff from non-process plant areas nor runoff from upstream acreage. This comparison does not provide a check of the estimated long-term flow but does provide a rough check that the above estimates are in the correct range.

The average flow along Swift Creek has been computed for several sites, as shown in Table 2.6-3. The estimated runoff per square mile for natural flow is lowered to 0.6 cfs per square mile at the most upstream site because there is much less baseflow at this location than at downstream sites. Figures are also included for current conditions assuming a current net flow augmentation of 24 cfs from Altman Bay Ditch and the outlet of Eagle Lake.

No attempt is made here to fully analyze the variation of low flows through Swift Creek. The lowest flows will occur when the plants are not operating or when the discharge is curtailed. It is believed that,

under natural conditions, a point of intermittency occurred some 6 miles from the mouth of Swift Creek (between monitoring sites SC 9 and SC 7). In this reach, the mean annual and 10-year 7-day low flows would have been zero. Estimates of the natural 7-day and 30-day lows at monitoring sites SC 1 and SC 4 (at the mouth of the stream and at the USGS gauge) are presented in Table 2.6-1. These low flow estimates will have to be incremented by the discharge from Occidental operations during drought periods. It is unlikely that Occidental would not curtail its discharges to conserve water required in the circulation system during droughts. On the average, based on a mass balance of stream loading at White Springs and Suwannee Springs, the existing records show that during periods of low flow, discharges from the Occidental operations have been approximately 40 percent and 27 percent of the 31 cfs long-term average discharge for the M(7,2) and M(7,10) low flows, respectively. Better estimates of the low and average flow conditions may be obtained when additional monitoring is available from the newly installed recording devices.

The effect of mining operations on Swift Creek flows after reclamation is completed should not be very significant. The decrease in runoff arising from an increase in evaporation from artificial lakes (possible

reduction of about 1.4 cfs for the potential reclamation plan* outlined in Section 2.3.3) would be somewhat offset by increased baseflow into streams due to the occasionally higher elevation of the reclaimed land surface and the improved transmissivity of the reworked overburden and reclaimed sand tailing areas, as well as by improved surface runoff from reclaimed clay settling areas.

2.6.2.2.4 Flood Flows of Swift Creek

Floods in Northern Florida normally occur in the late winter or early spring months; however, major flood-producing storms can occur at any time of the year. The summer flood season, more pronounced in Southern Florida, occasionally can produce the highest flow in a given year. Only one flood each water year was considered in this study; i.e., the highest flow occurring from October 1 of one year to September 30 of the next year. The peak flows reported by the US Geological Survey for 20 stations in North Florida and South Georgia, listed in Table 2.6-4, were analyzed to obtain a regional flood relation for this area.

The array of annual peaks for each station was fitted to a Pearson Log

*The actual reduction is probably less since a significant portion of the drainage basin experiences shallow ponding under natural conditions, and hence increased evaporation from these ponded areas.

III frequency distribution to obtain the return period (recurrence interval) of specific floods. The United States Water Resources Council (1976), describes the method used. Discharges expected to be equaled or exceeded once in 2, 5, 25, 50, and 100 years were determined for each station.

Since no two of these gauged streams are exactly the same and none are the same as Swift Creek, the flood frequencies were regionalized to determine the relationship of discharge to measurable geographic and hydrologic parameters. Years of experience and other studies indicate that the parameters expected to affect flood flows are as follows:

Climate:

Intensity and duration of storms of specific frequency.

Cultural:

Urban

Agricultural

Forest

Manmade Regulation (reservoirs and diversions)

Physical:

Size (drainage area, A)

Channel Length (L)

Channel Slope (slope of main channel - between 0.1L

and $0.85L$, S)

Storage (percent of basin in natural lakes, ponds,
and swamps, S_t)

Soil Infiltration Index (S_i)

Geologic Transmissibility (G , as measured by slope
of flow recession curve, or slope of the flow
duration curve)

Shape of Basin (L^2/A)

Orientation of Basin to Storm Travel (Azimuth, Az)

Orientation of Basin to Modifying Elements (water
source - ocean or gulf - valley, ridges, in-
dustrial particulate plumes)

Elevation of Basin (E)

Slope of Basin (land slope, as differentiated from
channel slope)

Many of these parameters drop out as insignificant when analyzed in a stepwise regression. The regression constant in a relationship for a particular area, such as North Florida, contains the effects of the most important parameters that do drop out. The relationship believed best suited to this area includes size, slope of main channel, and natural storage, as follows:

$$Q_{RI} = C_{RI} \frac{A^n S^{0.2}}{S_t^{0.4}}$$

$$\text{where } n = \left[\frac{0.12}{A+0.12} \right]^{0.05}$$

Q_{RI} = Discharge, cfs, for recurrence interval, RI

C_{RI} = Regional constant for recurrence interval, RI

The values of C for specific recurrence intervals, RI in years, are listed below:

RI (years)	2	5	25	50	100
C_{RI}	164	300	655	855	1094

This flow relation was used to compute flood flows for Swift Creek for conditions prior to any development. Table 2.6-5 lists computed flood discharges for pertinent points on Swift Creek based on the regression analysis.

The storage parameter in the relation used above to estimate flood discharges has been developed for off-channel ponded areas and lakes.

Swift Creek Swamp is an in-channel natural reservoir which will not only reduce flows from its own surface area but also flows from all upstream areas which have to pass through it. Computation of flood peaks for the natural stream must, therefore, consider attenuation of the flows from Swift Creek Swamp on the basis of reservoir routing. The flows originating below the swamp should be added to flows out of the swamp. For this purpose, flood flows have been computed for pertinent points on Swift Creek based on areas below the outflow from the swamp only. These flows are also presented in Table 2.6-5.

In order to determine flooding in Swift Creek Swamp and the peak outflows from the swamp, the Soil Conservation Service DAMS2 computer program was used to route the 2-, 5-, 25-, 50-, and 100-year flood hydrographs from 6-hour storm rainfall distributions through the outflow point of the swamp. The storage-elevation relation was developed from the 5-foot contours of the USGS topographic map supplemented by a few surveys taken in the bottom of the swamp prior to channelization. Because there is so little topographic expression in the area and so little survey data to accurately define a storage-elevation relation (i.e., area-capacity curve) for Swift Creek Swamp or an outflow rating curve at the original natural control section (in the southeast quarter of Section 3, Township 1 South, Range 15 East), the results of the

storage routing must be considered approximate. The stage-discharge rating for the swamp outlet was obtained from step-backwater calculations at the stream cross section where Swift Creek crosses the southern boundary of Section 3, Township 1 South, Range 15 East. The maximum water surface elevation in the swamp and the outflow for each flood are given in Table 2.6-6.

Modified flood peaks at pertinent points on Swift Creek have been determined based on a combination of the results of the routing and regression studies. A direct addition of swamp peaks and below berm peaks would not be appropriate because they do not occur simultaneously. Also, because of timing problems, the reduction of the swamp peaks cannot be directly subtracted from non-routed flow except right at the outflow section. Instead, an average of the two computations (i.e., flood routing and regression analysis) has been used and it is believed that the results are as good as may be obtained without extensive surveying and topographic mapping in the area. The averages of the flows computed by these two methods are presented in Table 2.6-7. These flows have been used to prepare the flood map which is discussed in the following section.

Modifications to-date in Swift Creek Swamp include channelization for

timber cutting, further channelization for mining, and the construction of a low berm along the southern edge of Sections 3 and 4, Township 1 South, Range 15 East (see Figure 2.6-1) that now separates Swift Creek Swamp from Swift Creek and, therefore, modifies future flood flows. In order to determine the effect of this berm on Swift Creek flood flows, the reservoir routing was recomputed for the outflow structure currently in place. The rating curve for the outflow structure during flood conditions has been developed assuming that the weir boards of the 36-foot long weir have been pulled down to an elevation of 113 feet (MSL), by accounting for two 84-inch conduits 100 feet long and considering a tail-water elevation defined by the rating curve downstream from the berm. Under these conditions the pipe entrance and exit losses will be the primary factors controlling outflow from the structure. The results of the routing (see Table 2.6-6) have been applied again to the flood peaks at pertinent points along Swift Creek. The resulting flood discharges are presented in Table 2.6-7. Mining operations would somewhat attenuate peak flows in Swift Creek because precipitation within the system is partially stored, at least temporarily, within water bodies. This reduction in peak flows should not, however, be appreciable and would be offset by increased flows from industrial discharges.

Flood flows originating on and around the proposed Swift Creek pro-

cessing facilities have been analyzed using SCS methods for small watersheds. Runoff characteristics have been estimated conservatively. The 25-year peak runoff should be about 400-450 cfs and the 100-year peak flow should be about 500-550 cfs. These flows will be carried to Swift Creek Swamp by two ditches. One of these flows to the east along the south end of Section 30, Township 1 North, Range 15 East (see Figure 2.6-1). This ditch was surveyed and was found to be adequate for handling flood water from the present and proposed facilities up to the 100-year flood.

Prolonged flooding of low flood plain areas by intermediate floods can have an effect on the ecology of these areas. The USGS step-backwater program was used to analyze the effects of increased flows from the Suwannee River Mine and Chemical Complex and the Swift Creek Mine on intermediate flows of Swift Creek which can continue for several days or weeks at a time. The intermediate flows used here are rates of 100, 140 and 165 cfs. The simulated daily discharge records developed for natural flow of Swift Creek have been analyzed for frequency of occurrence of maximum 7-, 15-, 30-, and 60-day rates of flow. From this analysis, it was determined that these flows would be equaled or exceeded during a certain percentage of years as follows:

<u>Duration</u>	<u>Percent of Years When Flows</u> <u>are Equaled or Exceeded</u>		
	Q: <u>100 cfs</u>	<u>140 cfs</u>	<u>165 cfs</u>
7 days	65	40	33
15 days	54	34	25
30 days	42	24	19
60 days	32	19	16

It would not be appropriate to give actual water surface elevations in this analysis. For such an analysis to be accurate, cross sections would be required every 400 feet of stream bed. The change in water levels would, however, be of interest. The current discharges have raised the water levels of Swift Creek by about 0.35 feet at most places during the wet winter season.

2.6.2.3 Swift Creek Flood Plains

Flooding can occur in several ways during periods of increased stream flow. When water levels are high, associated higher velocities potentially add to erosion. Under some circumstances, the higher volumes of water can back up into off channel depressions with essentially no velocity. Also, in headwater hydric areas, the ponded water has essen-

tially no velocity and dynamic stream flow conditions do not exist. Vegetation and soil-type mapping and/or reservoir flood routing methods will give more usable information for these headwater conditions.

Flood flows determined for Swift Creek by the methods described in Section 2.6.2.2.4 were related to channel cross-section properties to determine the water surface elevation at a particular point. Cross-section properties were obtained for sections indicated on the Swift Creek profile, Figure 2.6-6; from surveyed cross-sections (Nos. 1B, 2A, 3, 4, 5, 6, and 7B); and other cross-sections abstracted from USGS topographic maps. Figure 2.6-7 shows the location of these cross-sections. Roughness values for each cross-section were based on aerial photographs and verified by direct field observation.

Water surface elevations at each cross-section were calculated in a stepwise manner by balancing Bernoulli's energy equation between each pair of cross-sections starting with estimated elevations at the most downstream point. For Swift Creek, the initial elevation estimates for the five different flood discharges have been computed assuming uniform steady flow at the location of the USGS gauge at Cross-Section 1B. The step-backwater program E431 of the US Geological Survey was used to perform these calculations and the resulting elevations, for natural

buildings, roads and parking areas will be carried away through the existing drainage ditch system to Swift Creek.

Approximate boundaries of the 100-year flood prone areas as delineated by the US Geological Survey are shown in Figure 2.6-8. The areas outlined in Figure 2.6-8 were delineated through the use of readily available information on past floods rather than from detailed field surveys and inspections. No gauging station records were available for use in delineating these flood prone areas in the Swift Creek drainage basin particularly in upstream regions, where flood prone areas are based on a fieldman's indication of plant cover. Results from the step-backwater analysis and flood routing studies presented above should, therefore, be much more reliable than those presented in Figure 2.6-8.

2.6.3 GROUNDWATER QUANTITY

2.6.3.1 Hydrogeologic Setting

Within the region, there is a correlation between the physiographic provinces and the hydrogeologic environment. In the Northern Highlands, the Floridan Aquifer is under artesian conditions because it is overlain by low permeable sediments of the Hawthorn Formation of Miocene Age

conditions prior to mining and for the present channelization and development, are plotted on the Swift Creek profile, Figure 2.6-6. The outlines of the floods for natural conditions have been transferred onto corresponding USGS topographic maps and reproduced on the flood plain map, Figure 2.6-7. Backwater from bridges has not been included in the computations. To avoid ambiguity in narrow channel reaches, only the 2- and 100-year floods are drawn on the flood map. Addition of the 5-, 25-, and 50-year flood lines would overlap and mask interpretation of the results.

Ponding in headwater hydric bays, hammocks, and backwater pools have not been included in the flood plain map. The flood outlines are shown only part way into Swift Creek Swamp to the elevation obtained from the routing program, but have not been extended well into the swamp because of a lack of definition of topography in that area. It was noted, however, in the previous section, that the 100-year flood would probably have risen to about Elevation 123.8 feet (MSL) in Swift Creek Swamp.

No flooding is shown in the area of the Swift Creek plant site. This is because flooding in this flat upland ridge will be in the form of sheet flow which is not amenable to flood mapping. Storm precipitation on buildings, roads and parking areas will be carried away through the

which confine the water in the aquifer. The more permeable zones within the Miocene sediments comprise a secondary artesian aquifer while the sands overlying these sediments form a surficial aquifer. On the other hand, in the Coastal Lowlands, the Miocene deposits are absent and the Floridan Aquifer is under water-table conditions (except in localized areas where a perched water-table aquifer exists).

The occurrence and movement of groundwater is controlled in part by the geologic structure and the lithology of the sediments. Although all of the stratigraphic units yield some water to wells, the water-bearing characteristics of the units differ considerably. Those units yielding relatively large volumes of water are classified as aquifers, whereas the units consisting of materials of low hydraulic conductivity are classified as confining beds. Three major regional hydrogeologic units are recognizable in the site vicinity: the surficial aquifer, the Hawthorn confining unit, and the Floridan Aquifer.

Four sets of monitoring wells, each set consisting of three to five piezometers installed at different depths, have been located at the site of the proposed Swift Creek Chemical Plant. In addition, six sets of monitoring wells, each set consisting of three to four piezometers, have been installed at the site of the existing Suwannee River Chemical Plant

(see Figure 2.6-1). The location, depths and construction of these wells are shown in Figures 2.6-9 and 2.6-10. The wells were installed to determine the existing hydraulic gradient between the surficial and Floridan Aquifers and to obtain water samples from both aquifers and the confining unit for water quality testing.

The piezometric levels associated with the aquifers and confining deposits, as measured in these observation wells, are presented in Table 2.6-8 and Figure 2.6-11. At both sites, a head difference exists between the surficial aquifer and the Floridan Aquifer. At the proposed plant site, the head difference between the two aquifers is 80 feet. At the existing plant site, the head difference between the two aquifers is 57 feet. This head difference is dissipated across one or more layers of plastic clay present within the Hawthorn Formation.

2.6.3.2 Surficial Aquifer

The surficial aquifer is present in the Northern Highlands and in some localized areas in the Coastal Lowlands where perched water-table conditions may exist. It consists regionally of surficial sandy deposits overlying poorly permeable silts and clays that impede the downward movement of water.

At the Occidental property, the surficial aquifer consists of: (i) an uppermost deposit of Pleistocene fine sand which is under water-table conditions, varies in thickness from 3 to 15 feet and averages about five feet; (ii) a post-Miocene layer of silty and clayey sands, ranging in thickness from 5 to 20 feet, that generally underlies the surficial sand layer and acts as a semi-confining bed; and (iii) phosphatic silty and clayey sands and some of the weathered limestone just beneath the ore matrix (i.e., upper part of Member A of the Hawthorn Formation) which forms a water-bearing zone that generally exhibits the same hydraulic head as the surficial Pleistocene sands. The total thickness of the surficial aquifer is approximately 40 feet at the existing plant and approximately 60 feet at the proposed plant site.

The water level in the surficial aquifer is a subdued reflection of the topography. The water-table is at or within a few feet of the ground surface during the wet season, and fluctuates on the order of several feet per year in response to water inputs and outputs (see Figure 2.6-12). Recharge is primarily from precipitation and water outputs include evapo-transpiration, groundwater flow to streams, lakes or swamps, and recharge to the underlying Floridan Aquifer. Because of the low hydraulic gradients arising from the low degree of topographic relief, lateral flow of the surficial groundwater is localized.

The average ground surface elevation at the proposed Swift Creek Chemical Complex site is about 143 feet (MSL). Piezometers installed within the permeable units of the ore matrix (Wells B in Table 2.6-8) show that the piezometric water elevation ranged from about 138 to 141 feet (MSL) during the period of inventory; i.e., from 2 to 5 feet below ground surface. As shown in Figure 2.6-12, a small head difference of up to 1 foot exists at some locations between the water-table in the surficial sands (Wells A) and that in the ore matrix (Wells B), apparently due to the clayey sands which generally underlie the surficial sands. The same relationship is observed at the Suwannee River site except that the water level elevations are lower, reflecting the topographic relief and lower elevations at the existing plant site.

A controlled pumping test was conducted at the proposed plant site to evaluate the hydraulic properties of the surficial aquifer. The pump well and observation wells layout and the test results are shown in Figure 2.6-13. These results indicate that the storage coefficient of the permeable zone underlying the post-Miocene silty and clay equals about 0.00075 and that the transmissivity of this zone is on the order of 500 ft²/day. (The in-situ horizontal permeability of the phosphate ore matrix is, therefore, equal to about 10⁻² cm/sec). Wells tapping the surficial aquifer typically yield less than 50 gallons per

minute (gpm).

The pumping test results also indicate that the post-Miocene silty and clayey sands act as a semi-confining bed with a leakance of about 0.17 day^{-1} and a corresponding vertical permeability on the order of $6 \times 10^{-4} \text{ cm/sec}$. These in-situ values reveal that the semi-confining bed is more pervious than determined from laboratory tests on small specimens.

2.6.3.3 Hawthorn Confining Unit and Secondary Artesian Aquifer

The Hawthorn confining unit consists of plastic clays, clayey sands, sandstone and limestone. The clay layers impede the downward movement of water. Permeable zones composed of sand and/or limestone found within the Hawthorn Formation form a minor secondary artesian aquifer. These zones are lenticular and, where present, are underlain and overlain by beds of low permeability that confine the water under low artesian pressures. The secondary artesian aquifer is not areally extensive and wells tapping the aquifer generally yield less than 50 gpm. The aquifer exists in the Northern Highlands and is not found in the Coastal Lowlands where the Hawthorn Formation is absent.

During the US Geological Survey's investigation in the Osceola National

Forest, some 20 miles southeast of the Occidental site, a pumping test was conducted to determine the hydraulic characteristics of the secondary artesian aquifer, which was 20 feet thick at the Osceola National Forest. Analyses of the data indicated that the hydraulic conductivity of the zone tested was 0.75 ft/day and the storage coefficient was 0.000012 (Miller et al, 1977). No leakage coefficient could be determined from the test data.

At the Occidental site in Hamilton County, the Hawthorn Formation is approximately 100 feet thick. No permeable zones were found within the Hawthorn confining unit that are of sufficient thickness to be considered an aquifer (see Figure 2.6-9). In-situ packer tests indicate localized zones with horizontal permeabilities on the order of 10^{-3} cm/sec. In addition, at a depth of about 112 feet below land surface, a 3-foot layer of relatively clean sand in a matrix of clayey sand was encountered, and a monitor tube (Piezometer 3C in Figure 2.6-9) was installed to obtain water-quality samples and to determine the hydraulic head at that depth.

After Well 3C was installed and developed, a slug-discharge test was performed on the well to determine the hydraulic characteristics of the zone monitored. This technique involves the "instantaneous" removal of

a slug of water from a well and then monitoring the recovery of the water level in the well versus time. The data, as shown in Figure 2.6-14, were analyzed according to the procedure of Cooper, Bredehoeft, and Papadopoulos, as presented in Lohman (1972). The results of the analysis indicate that the transmissivity of the zone tested is equal to about 3.0 ft²/day. Assuming that the permeable zone is 3 feet thick, the hydraulic conductivity was calculated to be 0.96 ft/day (3×10^{-4} cm/sec), which is in good agreement with the value of permeability determined at the Osceola National Forest for a 20-foot thick member of the Hawthorn Formation.

As shown in Figure 2.6-11, the potentiometric surface in the Hawthorn Formation decreases with depth due to appreciable head losses in the confining unit. At the proposed plant site, the head difference between the surficial aquifer and the Floridan Aquifer is 80 feet. At the existing plant site, the head difference between the two aquifers is 57 feet. At both sites, most of the hydraulic head difference is dissipated across one or more layers of plastic clay present within the Hawthorn Formation between Elevations 40 feet (MSL) and 85 feet (MSL). At one monitoring station, however, the head was dissipated over a thicker section of the Hawthorn Formation. The significant head loss experienced as water moves downward through the primary confining unit

is indicative of the poor hydraulic connection that exists between the surficial and Floridan aquifers.

Although the USGS were unable to reliably determine the leakance of the Hawthorn confining bed from their pumping test program, they were able to estimate the leakance based both on a water-budget analysis and on an analysis of the water leaving the forest as underflow in the Floridan Aquifer. The water budget analysis was used to determine the amount of water available for recharge. The results of this analysis indicated a recharge range of 0 to 4 inches per year which agree with the calculated values for the Swift Creek drainage basin. The underflow analysis was used to determine the maximum amount of water flowing out of the forest through the Floridan Aquifer. The results of this analysis indicated a maximum value of 0.30 inches per year for the annual discharge rate through the Hawthorn confining unit (Miller et al, 1977). An underflow analysis at the proposed plant site does not yield an accurate rate of discharge through the confining unit because the Floridan Aquifer at the site is characterized by a high gradient for groundwater flow and significant lateral movement, and because the existing well data are not sufficient to establish an accurate flow pattern. An upperbound value for the discharge rate may be obtained by assuming that all the underflow across a given area comes from recharge within that area. Such an

analysis yields a maximum recharge rate of about 4 inches per year, but this value greatly overestimates the actual recharge rate since the largest portion of groundwater outflow at the site does not originate from site-specific recharge but rather from groundwater underflow because of the existing gradient in the Floridan Aquifer.

At the Osceola site, the Hawthorn Formation contains two identifiable confining units. At the proposed plant site, only one of these units (Member B) is present. The leakage coefficient for Member B at the Osceola National Forest, based on the maximum recharge rate of 0.30 inches per year and the measured thickness and gradient across this member at the forest, was computed to be $3.6 \times 10^{-6} \text{ day}^{-1}$. This value agrees very well with a leakance value of $2.9 \times 10^{-6} \text{ day}^{-1}$, calculated for the proposed chemical complex site using the measured head difference across the confining unit and the effective permeability of this unit (based on results from laboratory tests performed on samples of the clayey layers obtained from the core boring at the proposed plant site). This corresponds to a discharge rate through the Hawthorn confining unit at the proposed Swift Creek Chemical Complex of 1.0 inches per year.

2.6.3.4 Floridan Aquifer

The Floridan Aquifer is the primary source of groundwater in the area. It is composed of a sequence of formations that act as a single hydrologic unit; from youngest to oldest, these include the Suwannee Limestone, Ocala Group, Avon Park Limestone, Lake City Limestone, and Oldsmar Limestone. The Floridan Aquifer yields large supplies of fresh water to wells to depths up to 1800 feet. Below this depth, the rock is confined by relatively impermeable beds that contain moderately saline to very saline water.

The Floridan Aquifer is under artesian conditions in the Northern Highlands and under water-table conditions in the Coastal Lowlands (Figure 2.6-15). In the Coastal Lowlands, where the aquifer is under water-table conditions and surface-water runoff is low, primary water inputs are precipitation and surface-water inflows while the primary water outputs include evapo-transpiration, groundwater discharge to surface-water features and groundwater withdrawals. In the Northern Highlands, where the aquifer is under artesian conditions, the primary water inputs are groundwater recharge from the surficial aquifer by leakage through the Hawthorn confining unit and groundwater inflow from upgradient areas. The water outputs include groundwater discharge to

surface-water bodies, groundwater withdrawals and groundwater underflow to downgradient areas.

The potentiometric surface of the Floridan Aquifer in Hamilton County, shown in Figure 2.6-16, is at a significantly lower elevation than the water levels in the surficial aquifer. Fluctuations in the potentiometric surface occur in response to natural and artificial rates of discharges and recharges. In the past 28 years, based on records of a well in Lake City, the potentiometric surface has fluctuated as much as 18 feet with no apparent long-term trend (Miller et al, 1977).

Groundwater highs occur in south-central Madison County, in south-central Lafayette County, and in northern Columbia County. Groundwater flows downgradient to potentiometric lows perpendicular to the potentiometric contours through intergranular openings, cavities and solution channels. The groundwater discharge occurs in the coastal area and in major surface-water runoff features such as the Suwannee River, particularly downstream of White Springs. The fact that the Suwannee River is a major groundwater discharge feature may be seen in Figure 2.6-17, which shows that the only major springs located within the Northern Highlands occur along the channel of the Suwannee River. This is due to the fact that the Suwannee River has incised a channel into the Miocene

sediments, thus providing a hydraulic connection between the Floridan Aquifer and the river.

Observation Well 3D (Figure 2.6-9) installed at the proposed Swift Creek Chemical Complex site, in the Suwannee Limestone, taps an interval from about 140 to 155 feet below land surface. The piezometric water elevation (Table 2.6-8) which is indicative of the elevation of the potentiometric surface at the top of the Floridan Aquifer, was determined to be at 58 feet (MSL). Well 3E at the same site was installed within the Ocala Group and taps a more permeable unit of the Floridan Aquifer. The potentiometric surface elevation within this unit was measured at about 55 feet (MSL). At the existing Suwannee River plant, the potentiometric surface is somewhat higher (Table 2.6-8) in accordance with the regional direction of flow in the Floridan Aquifer (see Figure 2.6-16).

The hydraulic properties of the upper Floridan Aquifer in the vicinity of Lake City, Columbia County, were determined by the Florida Bureau of Geology. Analysis of the pumping-test data yielded an average value of transmissivity of 36,000 ft²/day and a storage coefficient of 0.0008 (Meyer, 1962). An accurate value for the coefficient of leakage could not be determined from the test data. The storage coefficient obtained is for the aquifer under artesian conditions. Under non-artesian con-

ditions, the storage coefficient could range from 0.01 to 0.20.

A pumping test was also recently conducted by the US Geological Survey during their investigation in the Osceola National Forest. This test was conducted on the upper 100-foot portion of the Floridan Aquifer, and as a result, the test data reflected the effects of partial penetration of the aquifer. Based on the results of this test and other studies, the transmissivity of the aquifer was conservatively estimated at 66,000 ft²/day, and the storage coefficient at 0.0001 (Miller et al, 1977).

At the Occidental site, the Floridan Aquifer is separated from the surficial aquifer by the confining beds of the Hawthorn Formation. As described in the previous section, the thickness of the primary confining unit at the proposed plant site is approximately 45 feet. The base of the Hawthorn is at about Elevation 10 feet (MSL).

Observation Well 3D (Figure 2.6-9), was installed in the Suwannee Limestone to determine the hydraulic head and the water quality at a depth from about 140 feet to about 155 feet below land surface. After the well was developed, an instantaneous slug-discharge test was performed to determine the hydraulic characteristics of the zone monitored. Analysis of the data, shown in Figure 2.6-18, indicates that the trans-

missivity of the zone monitored, which represents the top of the Floridan Aquifer, is about 6.5 ft²/day.

The more permeable zones of the Floridan Aquifer are located at the formation contacts within the Ocala Group, the Avon Park Limestone and Lake City Limestone. During the drilling of the existing Swift Creek Mine production wells, cavities were encountered at depths between 450 and 545 feet below land surface at the contact of the Avon Park Formation. Drilling of these wells was continued to a depth of 800 feet below land surface and each can produce more than five thousand gallons per minute.

Although no pumping tests have been conducted at the site to determine the hydraulic properties of the Floridan Aquifer, area pumping tests suggest that the transmissivity of the aquifer is on the order of 66,000 ft²/day and that the storage coefficient is about 0.0001 (Miller et al, 1977).

2.6.3.5 Effect of Mining Operations on Groundwater Flows

Phosphate mining operations in Hamilton County have impacted and will continue to impact the hydrologic system. These activities alter the

stratigraphy and character of the surficial aquifer and cause localized changes in the direction and amount of groundwater flow around mining areas. The topography is altered from flat to gently rolling (Section 2.3.3) and the reclaimed land is less stratified and looser than it was prior to mining (Section 2.5.5). In addition, the number of surface water-bodies is increased by the creation of lakes and the presence of mined-out pits.

In areas of active mining, the water-table is lowered due to dewatering. Upon reclamation, however, the water-table will recover to reflect the gently rolling topography, characterized by a greater degree of topographic relief than pre-mining conditions. The water-table might be slightly raised in some reclaimed areas (such as in reclaimed clay settling areas) and slightly lowered in others (such as in reclaimed sand tailing areas and around reclaimed lakes). The availability of water in the surficial aquifer should not, however, be affected by these operations.

Occidental Chemical Company currently withdraws approximately 30 MGD from the Floridan Aquifer for its mining and processing facilities. Eight industrial supply wells withdraw groundwater needed at the Suwannee River Chemical Plant, Suwannee River Mine and Swift Creek Mine,

as described in Table 2.6-9. These withdrawals undoubtedly cause a lowering of the potentiometric surface of the Floridan Aquifer in the vicinity of the supply wells. Miller et al (1977) analyzed long-term records from an observation well in Jennings, a well 3.5 miles west of White Springs, a well in Lake City and a well near Valdosta, Georgia. These records do not show any pronounced long-term water level decline when climatic variations are accounted for, which leads to the conclusion that pumping by Occidental Chemical Company has not produced a regional decline in the potentiometric surface. Miller et al (1977) concluded that the pumpage is balanced by an increase in the recharge to the Floridan Aquifer through leakage and/or capture of streamflow caused by the lowering of the potentiometric surface.

2.6.4 SURFACE WATER QUALITY

2.6.4.1 Regional Setting

Streams in the study area are similar when they are not affected by man's activities or do not receive extensive groundwater contributions. All streams in the study area, including the Suwannee River, are classified as Class III streams by FDER. Regulations applicable to Class III streams are presented in Table 2.6-10. Stream quality varies temporally in relation to the rates of surface runoff, derived largely from swamps and flatwoods, and in relation to groundwater discharge, derived largely from the surficial aquifer.

The Suwannee River enters Florida as typical swamp drainage with low pH (mean pH $\approx$ 4.5), high color, low hardness, low alkalinity and low specific conductivity. The river under these conditions is relatively infertile (FSBH, 1966). As the Suwannee flows south, large inputs of groundwater have an increasing influence on water quality, and the chemical composition of waters below White Springs varies more than that of most other streams due to the proportionately high input of water from the Floridan Aquifer (Miller et al., 1977). For example, White Springs, Suwannee Springs and Ellaville Springs add 44, 23 and 50 cfs, respectively (Ferguson, 1947). There are many other unnamed and unmonitored springs adding both flow and materials to the Suwannee. At Branford, the pH is above 7 and alkalinity, hardness and specific conductivity, among others, increase due to groundwater contributions. By the time the Suwannee reaches Vista, swamp waters probably comprise less than half the total flow (FSBH, 1966).

Swift Creek is similar to the Suwannee River in that it also receives drainage with high color and low pH. However, Swift Creek also receives a regular discharge from Occidental Chemical Company operations. The discharge is composed of nonprocess waters (well water origin), rainfall run-off, pit water discharge from the mining areas, and, infrequently, treated process water. This stream subsidy maintains a relatively constant flow in Swift Creek.

2.6.4.2 Data Sources

To assess long term trends and water quality USGS and FDER data were obtained from STORET (Table 2.6-11). The data were analyzed by regression analyses to better estimate the concentrations of selected chemical parameters under various flow conditions in study area streams. The regressions were also used to calculate mass loadings for various area streams under different flow conditions.

More than half of the variance in concentrations of some parameters at a given site may be explained by the variance in discharge; consequently, it is important to adjust for this relationship before calculating loadings or before quantitative interpretations are made for variations in concentrations over time at a given site. Because stream discharge follows a log-normal rather than a normal Gaussian distribution, discharge-concentration relationships are always determined on a log-log basis. The regression operations, correlation coefficients, and significance of the regression are given in Table 2.6-12. When the correlation coefficients were low, the estimated concentrations approach the arithmetic mean of the concentrations. However, it was felt that even with correlations the

estimated mean was better than straight arithmetic means. Means calculated by the regression equations are presented in Table 2.6-13.

The USGS and FDER data was supplemented by more area specific data for Swift Creek and some surrounding streams (Table 2.6-14).

Rocky Creek was sampled to provide background information on streams unaffected by phosphate mining. Miller et.al. (1977) considered Rocky Creek as unaffected by phosphate mining in their study of streams in the area. Hunter Creek was sampled to provide data representative of a stream which received only runoff and overflow from the mining pits. The southern half of the Hunter Creek basin has been disturbed by phosphate mining and beneficiation.

Sampling locations (Figure 2.6-19) included six stations along the Swift Creek main channel (Stations SC-1, SC-2, SC-4, SC-6, SC-7 and SC-9), two stations in small natural feeder streams (SCT-3 and SCT-5) and one station in Altman Bay Canal (Station ABC-8). Camp Branch Creek (Stations CB-1, CB-2 and CB-3), Rocky Creek (Station RC-2), Roaring Creek (Station RO-2) and Hunter Creek (Station HC-1) were also sampled to provide comparative data from other local streams. The Suwannee River was sampled a short distance (less than 0.5 mile) upstream (Station SR-7) and downstream (Station SR-8) of the mouth of Swift Creek.

Swift Creek stations were sampled in July, 1977 and then all stations were sampled monthly from October, 1977 to February, 1978. Since the data was collected over a relatively short period and over various flow conditions, means could be misleading. Therefore, only ranges are given in Table 2.6-14).

Sediment samples were collected from Swift Creek in July, 1977 and from all of the above stations in October, 1977 (Table 2.6-15).

The only available data for pre-mining conditions were given in an interim report of the Florida State Board of Health (1966), which sampled Swift Creek at three sites (above the Altman Bay Canal discharge point, at U.S. Highway 41 near Facil, and at its confluence with the Suwannee River) several times during the period May to October of 1965 (Table 2.6-16). The Suwannee River mine was being developed during this time, but mining of phosphate did not begin until a week before the August samples were collected. Methods used in sample collection, preservation and analysis are given in Appendix E.

2.6.4.3 Characterization of Occidental Discharge to Swift Creek

The Occidental discharge from the Suwannee River Chemical Complex (SRCC) and the Suwannee River Mine (SRM) mix in Altman Bay Canal and then enter Swift Creek. This discharge from the SRCC is composed of nonprocess water and rainfall on the plant site, which flows to a retention pond for turbidity control. Samples were taken at the outlet of the retention pond, the range of values and the mean are given in Table 2.6-17.

2.6.4.3.1 Treated Process Water

Due to a negative water balance in the recirculating water system treated process water is seldom discharged. When a seasonal imbalance of rainfall over evaporation occurs, discharge of treated process water can occur. The pond water is treated by a two-stage liming system. For a detailed discussion of the treating process, refer to

Section 1.3 A typical analysis of treated process water is provided in Table 2.6-18.

Treated process water has been discharged intermittently at a rate approximately 1000 gpm for about four to five months during the ten year history of the SRCC.

2.6.4.3.2 Altman Bay Canal Waters

The discharge from the present Suwannee River Chemical Plant and the Suwannee River Mine enters Swift Creek via Altman Bay Canal. The nonprocess water and treated process water then discharged, mix with rainfall runoff and water from the mine in Altman Bay Canal. After allowing a reasonable distance for mixing, the canal was sampled to determine the quality of water entering Swift Creek. A comparison of the Altman Bay Canal, Swift Creek, groundwater from White Springs and groundwater from Occidental Deep Wells indicate that levels of phosphate, fluoride, sulfate, nitrogen and TOC in Altman Bay Canal are higher than those of the groundwater from the Floridan Aquifer and Swift Creek (Table 2.6-19).

2.6.4.4 Background Conditions in Swift Creek

USGS has monitored Swift Creek at Facil (Station 02315520) since 1967 (Table 2.6-20). To determine if significant trends developed during this period, the annual means of important parameters were compared statistically. The analysis indicated no significant differences in concentrations of organic-nitrogen, ammonia-nitrogen, nitrate-nitrogen, total organic carbon, dissolved fluoride and orthophosphate for the period of record (Table 2.6-21). A slight increase occurred in sulfate and total phosphate as P concentrations

from 1971 through mid-1977 (Tables 2.6-20 and 2.6-21). This indicates that Swift Creek has had relatively constant concentrations of nutrients for a number of years and that the present aquatic system should have responded to the change from pre-1965 conditions.

Part of the lack of significant differences may be attributable to the sampling frequency and temporal variations. However, graphs of the USGS data presented by Coffin (1977) show a similar lack of significant trends.

2.6.4.4.1 pH

Area streams typically are acidic since they usually drain swampy areas with low pH waters. The low pH is due to organic acids released during decomposition of organic matter.

The long-term mean pH in Swift Creek at the USGS sampling stations was 5.1 with a minimum of 4.1 and a maximum of 6.8 (USGS STORET, 1967-1977). Since the creek is relatively weakly buffered, as evidenced by the low total alkalinity (14 mg/l average), it can fluctuate fairly widely by additions of more acidic or alkaline waters and the reductions or additions of CO₂ due to respiration of both plants and animals.

The Occidental discharge into Swift Creek causes the pH to rise from about 4.1 (SC-9.5, Table 2.6-14) above confluence with Altman Bay Canal to approximately 6.6 (SC-7, Table 2.6-14) just below confluence with the canal. This elevation in pH is beneficial since it causes less stress to the aquatic organisms. Reproduction and growth are both adversely affected when the pH is below about 5.

Studies with fathead minnows indicated that at pH 4.5 behavior was abnormal and that fish were deformed (Mount, 1973). Both EPA and DER state that the pH should not be depressed below 6.0 for Class III waters except when background conditions are below 6.0.

2.6.4.4.2 Phosphate

Phosphate concentrations in Swift Creek are high (mean=18.8 mg/l P, USGS STORET) in comparison to other area streams such as Rocky Creek (mean= 0.18 mg/l P, USGS STORET) which is unaffected by phosphate mining. However, even before Occidental began mining in the area, Swift Creek had relatively high phosphate concentrations (mean= 1.4 mg/l P, FSBH, 1966). These high levels were probably related to the acidic waters flowing over and through the high phosphate rock in the area.

Even though phosphate levels in Swift Creek are high and have been high for many years, no problems have been reported due to the elevated phosphate levels. The absence of excessive growths of aquatic plants and nuisance algal blooms in the presence of high phosphate levels indicates that some factor other than phosphate is limiting in the system.

Chu (1943) reported that once phosphate exceeded about 0.1 mg/l P that no increased growth of several species of algae occurred. Generally, 0.05 mg/l P is considered about the maximum phosphate can reach and still be considered limiting. Both EPA and DER are concerned about protecting waters with naturally low concentrations of phosphates. DER states in their proposed 17-3 regulations that "consideration shall be given to the protection from nutrient enrichment of those

waters presently containing very low nutrient concentration; less than 0.3 mg/l total nitrogen or less than 0.04 mg/l total phosphorus." EPA (1976) states similar opinions in their Quality Criteria for Water in which they establish criteria for streams flowing into lakes or reservoirs which may accumulate phosphates. No DER or EPA regulations exist for waters with phosphate levels greater than 0.04 mg/l P.

2.6.4.4.3 Nitrogen

Total nitrogen concentrations are higher in Swift Creek than in other area streams (Table 2.6-14). The higher nitrogen levels in Swift Creek are primarily due to elevated levels of ammonia-nitrogen which enter Swift Creek via the Occidental discharge. The ammonia is quickly oxidized to nitrate by microorganisms in the presence of oxygen. Nitrite is an intermediate product in the oxidization, but it is quickly oxidized and is generally low.

Ammonia-nitrogen can be toxic in the un-ionized form. Its form is dependent on pH and temperature. As the pH and temperature increase, the percentage of ammonia-nitrogen in the un-ionized form increases which in turn increases the toxicity. EPA (1976) states that the concentration of un-ionized ammonia should not exceed 0.02 mg/l NH_3 which is one-tenth the lowest level shown to be toxic to the most sensitive species tested. By using Table 2.6-22 it is possible to determine the concentration of measurable ammonia-nitrogen that will give a concentration of 0.02 mg/l NH_3 . USGS data for ammonia-nitrogen concentrations, pH and temperatures at their monitoring station on Swift Creek indicate that the conditions which could result in 0.02 mg/l NH_3 occurred only once (February, 1974) over the period ammonia-nitrogen levels were measured (1971-1977) (Tables

2.6-22 and 2.6-23). This case was only borderline and would not have caused the death of any organisms since the 0.02 mg/l level is one-tenth the known toxic level. Biological sampling did not indicate any stress on aquatic organisms (Section 2.7).

Nitrate and nitrite nitrogen values are also higher in Swift Creek than in natural streams (Table 2.6-12). Its progressive increase in concentration downstream indicates it is due to the oxidization of the ammonia-nitrogen (Table 2.6-22). During the sampling program for the EIS it ranged from 0.33 to 3.33 mg/l at SC-7 to 1.14-4.40 mg/l at SC-1 (Table 2.6-14).

Organic-nitrogen levels in Swift Creek were about equivalent to those in natural streams which drain swampy areas. The organic-nitrogen concentrations are mostly due to the decomposition of organic matter in swamps and forest litter.

2.6.4.4.4 Fluoride

Fluoride concentrations in Swift Creek are elevated due to the Occidental discharge. According to USGS data fluoride has ranged from 2 mg/l to 29 mg/l with a mean of 6.6 mg/l during the period from late 1967 to mid-1977. The FDER regulations set a maximum of 10 mg/l for Class III waters. Although this level was exceeded five times during the period of record, only two values were appreciably above the FDER limit of 10 mg/l.

A fluoride study is underway to assess the impact of ambient fluoride levels on terrestrial and aquatic organisms in the study area and in

the Suwannee River. It is anticipated that the data will be included in the final EIS document.

2.6.4.4.5 Sulfate

Sulfate levels in Swift Creek are relatively high (mean 153 mg/l) in comparison to other area streams such as Rocky Creek (mean 11 mg/l) (Table 2.6-12). This is due in part to the influence of the sulfate in water from the Occidental deep wells and to the use of sulfuric acid in the beneficiation process. No EPA or FDER regulations exist for sulfate. However, the USPHS drinking water standards place a 250 mg/l limit on drinking water. However, this limit is based on esthetics and not on taste or toxic properties of sulfate (EPA, 1974).

2.6.4.4.6 Coliform

Coliform counts show a gradual decline over the period of record. In the years 1969 to 1972, counts greater than 10^4 per 100 ml were observed once each summer or early fall, but since the beginning of 1973, the maximum count has dropped to about 4.5×10^3 per 100 ml with 10 out of 22 measurements being less than 10^3 per 100 ml. The standard for total coliforms in Florida Class III waters is 10^3 per 100 ml as a monthly average. If the bimonthly samples for a given year are averaged, the means for 1974 and 1976 exceed the standard for the monthly means, but the annual means for 1973 and 1975 are within the standard. Because no information is available on counts of fecal streptococci in the stream, the relatively high counts of total coliforms cannot be taken as conclusive evidence for contamination by sewage. Many sources for total coliforms can occur in the natural environment.

2.6.4.4.7 Heavy Metals

Except for iron, all heavy metal concentrations are low and at background levels at all stations. Both dissolved and total iron concentrations are moderately high, but no spatial trends are shown, and the concentrations represent natural levels. Mean values for all sites are well within the standards (1.0 mg/l), but maximum values for total iron in Rocky and Hunter Creeks exceed the standard slightly. There is no evidence for any heavy metal contamination in the surface waters; mercury, cadmium, copper, cobalt and chromium (VI) levels were generally less than 1 µg/l. Lead levels were low, with mean values ranging from 3 to 7 µg/l. The probable source of lead in the surface waters is atmospheric deposition of lead from combustion of gasoline and other fossil fuels.

2.6.4.5 Chemical Conditions in Sediments from Streams

Table 2.6-15 gives results for 15 chemical parameters determined on sediment samples collected from each of the 18 stream sampling locations. Two sets of sediment samples were collected from Swift Creek and tributaries to Swift Creek (July and October, 1977) and one set of samples was collected (October, 1977) from the other stations.

These sediments were generally firm and consolidated, as indicated by the relatively low moisture contents (generally 20-30 percent). Stations SC-6 and SC-7 in Swift Creek had somewhat higher levels of moisture (31-41 percent), and these sediments were somewhat softer in consistency. The sediments were near neutral in pH; the range encountered for all stations was 6.15 to 7.55, and most stations had pH values slightly under 7.0. Ammonium and organic nitrogen

levels were low in the sediment samples, and the values reflect the low concentrations of organic matter in the sediments. Highest concentrations of organic nitrogen occurred at SC-6 and SC-7 where sediments had a higher organic content.

Sulfide concentrations were low (<5 ppm) in sediments from Roaring, Rocky, Hunter and Camp Branch Creeks; from the two small tributaries (SCT-3 and SCT-5) to Swift Creek, and from the Suwannee River; but concentrations were higher in Swift Creek. Considerable differences were found between the two sampling dates, thus limiting the conclusions that can be made regarding sulfide levels in Swift Creek sediments. Evidently the substrate at a given stream location is quite heterogeneous. Sulfide concentrations were high at Stations SC-4, SC-6 and SC-7; the latter station had the highest values encountered (170-400 ppm). Concentrations were near the background levels of the other streams at the mouth of Swift Creek (SC-1) and above the drainage ditch of the Occidental Plant (SC-9 and SC-9.5).

Sediment phosphate concentrations are high in all streams except the Suwannee River and Rocky Creek (which had concentrations less than 125 ppm). Sediments from the Swift Creek headwaters (SC-9.5), from the small tributary to Swift Creek (SCT-3) and from Roaring Creek had moderate concentrations (300-700 ppm), whereas all other stations had levels of 1000 to over 5000 ppm (0.1 to 0.5 percent). The high concentrations in sediments from Camp Branch Creek are surprising in that this creek is unaffected by phosphate mining activities. These concentrations probably reflect the high concentrations of phosphate in surficial soils and mineral deposits of the area.

Heavy metal concentrations in the stream sediments are all low except for iron at some stations (see Table 2.6-15). Mercury was undetectable (less than 0.0001 mg/g) at most sites and just above the detection limit at the other sites. Similarly, arsenic was below detectable limits (less than 0.0002 mg/g) at most stations in Swift Creek, but low concentrations (less than 0.001 mg/g) were found at a few stations and in sediments from the other streams. Cadmium concentrations were all less than 0.002 mg/g (most stations were less than 0.0005 mg/g) and no trends could be noted between streams affected by phosphate mining activities and control streams. Similar statements apply to zinc and manganese. Copper, chromium, and lead concentrations were at apparent background levels at all sites except for the looser sediments at Swift Creek stations SC-6 and SC-7 which are in a swamp area where sediments had a higher organic content, and some of the differences can be attributed to natural differences in substrate conditions. Similarly, the higher phosphate levels in the sediments of Swift Creek, compared to some of the other streams, may also reflect natural differences in substrate since sediments from Camp Branch Creek, which is unaffected by phosphate mining and processing activities, had phosphate concentrations comparable to the elevated levels at some stations in Swift Creek.

2.6.4.6 Biological Indicators of Water Quality

Biological indicators of water quality give a much better indication of long-term water quality than do grab samples for chemical analyses because grab samples only yield information about a single point in time.

Data on the aquatic communities in Swift Creek (Sections 2.7.4.1.3, 2.7.4.1.2 and 2.7.4.1.4) indicate that organisms in Swift Creek have not been adversely impacted by the concentrations of referenced parameters and the increased, but relatively stable, flow conditions.

No significant differences were detected ($P < 0.05$) between diversity indices for fish populations in Swift Creek and those in streams which represent a natural state with no mining influences. Periphyton and macroinvertebrate diversity and equitability indices were both above the levels indicating stress (EPA, 1973) and were not significantly different ($P < 0.05$) from indices for natural streams (Section 2.7.4.1.4).

Thus the biological indicators of water quality do not indicate any significant stress or degradation in Swift Creek water quality, even though concentrations of nutrients, sulfate and fluoride are higher than concentrations in natural streams.

2.6.4.7 Influence of Swift Creek and Other Major Tributaries on the Suwannee River

Swift Creek discharges into the Suwannee River just below White Springs. Mass loadings for important parameters were calculated based on flows and chemical parameters measured at USGS stations on Swift Creek, the Suwannee River and its major tributaries (Figure 2.6-20). Mass loadings based on flows (Table 2.6-1) and estimated concentrations (Table 2.6-13) from regression equations (Table 2.6-12) were calculated as follows: $\text{MASS (kg/day)} = \text{flow(cfs)} \times \text{concentration (mg/l)} \times \text{a conversion constant (2.45)}$. The mass loadings were calculated for phosphate, total nitrogen, total phosphate, dissolved

fluoride and sulfate under average flow (Table 2.6-24) and low flow (M7,10) conditions (Table 2.6-25). These values were used to assess the contribution of nutrients to the Suwannee River from Swift Creek and other major tributaries.

The calculated percentages of mass loadings attributed to various stream inputs to the Suwannee should be considered high because the mass loadings of the input streams were not corrected for the portion of the nutrients lost before the water reached the downstream station. A portion of the nutrients from an input source could be 1) incorporated into plant and animal biomass, 2) settled out due to slower current velocity and/or 3) precipitated due to changes in pH or reactions with other chemicals in the water which form more insoluble compounds. Thus the true mass loading resulting from a point source input will decrease with increasing distance from its input. If enough data were available, a correction factor could be applied for this. However, this type of data is not available for the streams under consideration here.

Based on calculations from available data, the following conclusions were drawn. Swift Creek could contribute up to a maximum of 81 percent of the phosphate, 40 percent of the fluoride, 43 percent of the sulfate and 23 percent of the total nitrogen measured under average flow conditions at Suwannee Springs USGS Station 02315550 on the Suwannee River. The percentage contributions Swift Creek drop to a maximum of 73 percent of the phosphorus, 13 percent of the fluoride, 7 percent of the sulfate and 7 percent of the total nitrogen measured in the Suwannee at USGS Wilcox Station 02323500. These relatively high percentage increases should not be misinterpreted.

While a mass balance allows determinations of the relative importance of the various sources and sinks of materials in a system, the actual impact is a function of concentration. For example, although the percentage increases of phosphate seem high, the concentrations at the respective stations are 1.11 mg/l P, 0.21 mg/l P and 0.17 mg/l P at Suwannee Springs, Branford and Wilcox, respectively.

Contributions of nutrients added under low flow conditions were also calculated (Table 2.6-16). However, these calculations are unreliable for total phosphate as P, sulfate and fluoride since the mass at Suwannee Springs is below the amount computed to be added by Swift Creek. This is obviously impossible since the mass loading should theoretically always increase unless a known sink occurs.

Possible explanations for this apparent decrease are: (1) that the estimated discharge from Occidental is too high for the periods of low flow or (2) a portion of the phosphate, sulfate and fluoride may be present as suspended particles which could settle out in the Suwannee due to its slower velocity at low flow.

Data was not available to adequately determine the amount of Occidental discharge under low flow conditions. Therefore, the average discharge was used to determine the mass concentration under worst case conditions.

The relative relationships of the mass contributions of the major tributaries of the Suwannee River and the mass loadings at the USGS

monitoring stations is presented graphically in Figure 2.6-21. The contributions of the Alapaha River could not be determined due to the distances between the USGS monitoring station and the fact that the majority of the river goes underground before entering the Suwannee.

Swift Creek was shown to have high levels (1.6 mg/l P) even before Occidental began mining in the area (FSBH, 1966). The present concentration in Swift Creek averages 18.5 mg/l P. Swift Creek contributes the majority of the phosphate contained in the Suwannee River. It contributes from 4 to 9 times the amount added by the other major tributaries. While the majority of the phosphate appears to enter the Suwannee from Swift Creek, this does not appear to be the case for other parameters measured under average flow conditions.

Three times as much nitrogen enters the Suwannee River from the Withlacoochee as from Swift Creek (Table 2.6-24). Although insufficient data were available to make calculations for the Alapaha and Santa Fe Rivers, they probably add similar amounts. Run-off from agricultural lands and forests is a contributing factor in the nitrogen content of these tributaries.

Swift Creek adds relatively small amounts of total organic carbon to the Suwannee River. The Alapaha and Withlacoochee Rivers both add 15 to 20 times the Swift Creek mass contribution of total organic carbon (Table 2.6-15). Run-off from forest and drainage from swamps probably also adds high amounts during periods of heavy rainfall.

The Withlacoochee, Alapaha and Santa Fe Rivers' sulfate mass contribution are 103, 21 and 380 percent, respectively; as much as the Swift Creek contributions (Table 2.6-24). This probably reflects the relative amounts of groundwater they receive, since sulfate is relatively high in groundwater. The high sulfate concentrations in Swift Creek result from groundwater (Table 2.6-19) and from that picked up in the nonprocess water due to plant activities.

Fluoride concentrations in the Suwannee River are below both the FDER 10 mg/l maximum for Class III waters and the 1.6 mg/l maximum for Class I potable waters. Major contributors of fluoride to the Suwannee at average flow are Swift Creek (766 kg/day), the Alapaha River (398 kg/day) and the Withlacoochee River (1380 kg/day). The Santa Fe is also probably a major contributor; however, there were insufficient data to project a fluoride loading (Table 2.6-24).

A study is underway to assess the effect of fluoride on aquatic and terrestrial organisms in Swift Creek and the Suwannee River. It is anticipated that data will be included in the final EIS and resource documents.

2.6.4.8 Summary

2.6.4.8.1 Swift Creek

Swift Creek has high concentrations of sulfate, phosphate and fluoride when compared to other area streams. It is strongly influenced by the discharge from Occidental Chemical Company.

Biological indicators of water quality which give a long-term assessment of conditions in streams indicate no severe stress to the aquatic system in Swift Creek. Community diversity and biomass are not significantly different from other area streams.

2.6.4.8.2 Suwannee River

Based on mass loadings calculated for average flow conditions in each of the major tributaries of the Suwannee, Swift Creek contributes the majority of phosphate to the Suwannee, while the Withlacoochee contributes the majority of the total nitrogen, total organic carbon and fluoride. The Santa Fe River contributes the majority of the sulfates to the Suwannee.

Since nitrogen and phosphate concentrations in the Suwannee River are high and there have been no indicators of nutrient related problems, other nutrients or physical factors must be limiting to aquatic plants in the river. The mixing due to the relatively high velocity of the river and its highly colored water which limits light penetration are probably major limiting factors preventing utilization of the available nutrients.

Water quality in the Suwannee River has not changed significantly since 1967 according to a series of reports by Coffin (1977). The reports began approximately two years after Occidental began mining in the area.

2.6.5 GROUNDWATER QUALITY

2.6.5.1 Sampling Program

Analyses for major and minor chemical constituents were run on samples from several sets of observation wells located downgradient from the proposed Swift Creek gypsum stack-cooling pond complex. These wells were installed to determine the existing hydraulic gradient between the surficial aquifer, the Hawthorn confining unit and the Floridan Aquifer and to obtain water samples for water quality testing. Locations of the well sets are shown in Figure 2.6-22; boring logs and individual well characteristics for the fifteen observation wells were presented in Figure 2.6-9.

Three to five wells of varying depth were installed in each of four well sets. Within each set, wells were labeled "A," "B," "C," "D," or "E" in order of increasing depth of collection zone. "A" wells were located in the shallow surficial sand water-table aquifer (<10 feet deep); "B" wells were generally installed in the water-bearing zone of the upper Hawthorn Formation (i.e., in the ore matrix) which comprises the lower portion of the surficial aquifer; "C" wells were located at deeper depths within the Hawthorn confining unit; and Wells "D" and "E" of Set

3 penetrated the Floridan Aquifer and tap zones in the Suwannee and Ocala limestone, respectively.

All wells of Sets 1, 2, and 4 and the two shallower wells of Set 3 were rotary drilled to the desired elevation. The nominal diameter of these wells was 4 inches. A minimum one-foot thick layer of silica sand was tremie-packed at the bottom of the hole (see Figure 2.6-9). A two-inch slotted PVC pipe surrounded by silica sand formed the collection zone and was overlain by a thin bentonitic seal. A bentonite-cement grout mix extending to ground surface formed the main seal for these wells.

As shown in Figure 2.6-9, Piezometers C, D and E of Set 3 were installed in the same rotary drilled hole, which had a nominal diameter of 8 inches. The collection zone of these piezometers consisted of a washed 3/8-inch size gravel (passing the 3/8-inch mesh and retained on U.S. No. 20 sieve) tremie-packed below, around, and above the monitor tube screens (Figure 2.6-9). Each screen consisted of a 5 to 10-foot long 2-inch diameter slotted, schedule 40, PVC screen (except for Piezometer 3-C where a 6-foot long porous polyethylene tip was used). A silica sand cap having a minimum thickness of 3 feet was placed above each gravel pack by the tremie method. Each of the collection zones was sealed with a bentonite-cement grout mix.

All wells were flushed, primed and developed after installation using water from production wells tapping the Floridan Aquifer. Each observation well was sampled four separate times since January, 1978, and prior to the first sampling, a volume of water equivalent to the full volume of the well was pumped out. Nevertheless, the first sampling still reflected the presence of some Floridan Aquifer water. This was especially the case in some of the shallower wells as exhibited in Table A2.6-2 (of Appendix A2.6.2) by increased sulfate concentrations, for instance (Sample Set "W"). The wells were again sampled two to four weeks after the first sampling date for their water quality (Sample Set "X"). The latest two water quality samples were taken on the same day in April, 1978: one prior to pumping the wells (Sample Set "Y") and one immediately following pumping a full volume of the well (Sample Set "Z"). The last three water quality samples ("X", "Y" and "Z") generally did not exhibit significant differences or trends in water quality parameters, and therefore are representative of ambient groundwater conditions.

In addition to the observation wells drilled specifically for this study, several existing water supply wells at the Swift Creek Beneficiation plant were sampled, and analyzed for major chemical constituents. Historical data on wells in the surficial aquifer, Hawthorn Formation,

and Floridan Aquifer were also obtained from Miller et al (1977). For comparative purposes, return water from an existing ditch adjacent to the settling area at the Swift Creek mine was also sampled (see Figure 2.6-22).

All available results for the observation wells and water supply wells at the Swift Creek site are listed in Appendix A2.6.2, along with information on depth of collection zone, water level elevation, and sampling date. Table 2.6-27 summarizes the results from the last sampling set. Levels of important parameters of groundwater quality are graphed versus well depth in Figures 2.6-23 through 2.6-26 with the range from three to four sampling sets shown for each observation well, over a depth corresponding to the collection zone.

In some cases, the concentrations of sulfate, calcium and total hardness measured in the first set of analyses (Sample Set "X") were markedly different from the three later samples. The latter three samples usually gave quite consistent concentrations, and it was concluded that the first set of analyses were not always representative of the existing groundwater conditions and may have reflected impacts of initial flushing and priming of the wells. Consequently, these data were not considered in graphing the concentration profiles shown in Figure 2.6-25

and 2.6-26. Furthermore, as discussed below, results from Wells 3-C and 3-D reflect contamination from cement grouting. Hence, the pH, conductivity, calcium and total hardness data from Wells 3-C and 3-D were not considered in graphing the concentration profiles.

2.6.5.2 Water Quality in Surficial Aquifer and Hawthorn Formation

In general, the waters in the surficial sands (<10 feet thick) are acidic, with pH values usually between 4.5 and 6.5. A trend of increasing pH with increasing depths is evident, with pH levels ranging from about 6 to 7.5 in the phosphate matrix layer (depths of 20-50 feet) and above 7.0 at greater depths. The high pH values (up to 11-12) found in Wells 3-C and 3-D (and on one or two occasions in Wells 2-C and 4-C) evidently reflect contamination from grouting and should not be considered representative of the pH level in the aquifer. Wells 3-C and 3-D never came to normal pH values, and the high levels of potassium, calcium, sodium, strontium and specific conductance found on all three sampling dates are not representative of the ambient groundwater and are likely due to contamination from cement grouting. This condition should correct itself with time as the cement grout is leached with groundwater.

Specific conductance levels were less than 100 $\mu\text{mhos/cm}$ in two of the surface wells (1-AA and 2-A); no water could be obtained from Well 3-A during the sampling period; and Well 4-A, which was atypical of the other surficial wells, had a higher conductance (200 $\mu\text{mhos/cm}$). Conductance levels in the Hawthorn Formation generally ranged from 200 to 400 $\mu\text{mhos/cm}$, except for those samples with high pH (>11), where leaching of alkaline salts from grouting is suspected.

Fluoride levels ranged between 0.12 and 1.8 mg/l in all the wells over all dates, but only four of 46 measurements were equal to or greater than 1.0 mg/l. There does not appear to be any pronounced trends with depth, although the lowest levels (0.12 - 0.18 mg/l) consistently were found in Well 2-A.

Total hardness (Figure 2.6-25) showed a general increase at all sites from the A-wells to the wells in the Hawthorn Formation; but within the latter formation, concentrations were variable and no trends with depth could be discerned.

Trends similar to those for fluoride were found for calcium, magnesium and alkalinity, as expected. The surficial wells had very low levels of the latter parameter.

Chloride levels are rather low in all well sets and at all depths. Except for Well 4-A, the range for all samples was 3 to 9 mg/l; Well 4-A had somewhat higher levels (23-27 mg/l). Except for Set 4, no trends are evident versus depth.

If the first set of samples from each well are not considered (for reasons of contamination, as discussed above), sulfate levels are rather consistent with depth and seldom above 10 mg/l (Figure 2.6-26). Well 4-A again was an exception with concentrations of 39-40 mg/l found on two occasions in this well.

Orthophosphate concentrations (Figure 2.6-24) ranged from less than 0.1 mg P/l to about 3.0 mg P/l in the surficial aquifer, but of the three shallow wells, only 1-AA had orthophosphate levels greater than 0.3 mg P/l. The matrix zone had generally higher but rather variable concentrations (0.13 to 9.2 mg P/l). Variations occurred within each well over time (as indicated by the wide range for each well in Figure 2.6-24). However, Well 3-B generally had the highest levels. Deeper in the Hawthorn Formation (C-series), orthophosphate ranged up to about 3.2 mg P/l. In a few cases, total phosphate levels were considerably higher than orthophosphate concentrations (see Appendix A2.6.2), and in these cases the samples contained high levels of suspended sediments that were

apparently pumped through the screen. Thus, these high values are not representative of phosphate levels in the aquifer per se. Furthermore, these cases usually represented the highest values of orthophosphate and possibly these values are also higher than ambient levels in the groundwater, because dissolution or leaching of orthophosphate into the water could have occurred after sampling and prior to analysis.

Nitrate levels were very low at all sites and depths, and the maximum concentration found was generally less than 0.12 mg N/l (Figure 2.6-26). No significant trends over time or depth are apparent in nitrate levels.

Ammonium concentrations, on the other hand, tended to increase with depth. All concentrations were less than 1.0 mg N/l and most were less than 0.5 mg N/l. (A maximum of 1.5 mg NH_4^+ -N/l was found in Well 3-C on the first sampling date, but as noted above, this well is thought to be contaminated.) The surficial aquifer had concentrations ranging from <0.02 to 0.20 mg N/l (except for Well 4-A which exhibited a concentration of about 0.6 mg N/l on one occasion).

Color is essentially absent in all the deeper wells, but the surficial aquifer had up to 180 Pt units (Well 4-A). Iron concentrations also were highest (0.9 to 7.5 mg/l) in the surficial aquifer and exceeded the

recommended maximum 0.3 mg/l for iron in drinking waters. In the phosphate matrix and in the Hawthorn Formation, iron values were somewhat lower (0.2 to 5.2 mg/l) but still exceeded the drinking water standard. On the other hand, manganese levels were much lower (<0.002 to 0.088 mg/l), and most samples (30 out of 43) were within the recommended drinking water standard (0.050 mg/l). Other heavy metals had low to undetectable concentrations in all wells.*

In summary, groundwater quality in the surficial and Hawthorn layers at the Swift Creek site is somewhat variable over depth and time. The water found in the upper portion of the surficial aquifer is acidic, soft, somewhat colored, high in iron and generally low in dissolved solids. As the water percolates downward through the system and enters the ore matrix and lower portions of the Hawthorn Formation, its quality reflects increases in conductivity, dissolved solids, hardness, ammonium, calcium, and magnesium and a decrease in color. These increases and decreases are typical for areas in Florida where a phosphate ore matrix is present. Acidic surface water containing carbon dioxide enters the surficial sands and initially dissolves into solution those ions present in the surficial aquifer deposits. Limestone, dolostone,

*Radio-chemical data is discussed in Section 2.9.

clays and phosphatic material that underly the surficial deposits provide an abundant source of chemical constituents which can react with the acidic water causing further geochemical changes. The Hawthorn Formation has generally hard water with neutral to alkaline pH. Levels of phosphate are relatively high in this zone, as expected from the geochemistry of the region. Iron is also high throughout the Hawthorn Formation and frequently exceeds drinking water standards. Heavy metal pollution is absent and concentrations of other major ions are in the typical range for waters of the Hawthorn Formation.

2.6.5.3 Water Quality in Floridan Aquifer

Groundwater quality from Occidental supply wells tapping the Floridan Aquifer at depths ranging from 170 to 800 feet are in general agreement with the regional data (Meyer, 1962; Shampine, 1975; Miller et al, 1977), the water being classified as a calcium-magnesium bicarbonate type.

Appendix A2.6.2 (Table A2.6-3) presents water quality data for an Occidental shallow potable well (SCD-1, 168-270 feet deep) and two 800-foot deep production wells (SC-1 and SC-2) at the Swift Creek Beneficiation Plant. In addition, observation well 3-E was drilled to

the Floridan Aquifer, and results from three analyses on this well are also given in Appendix A2.6.2. (Table A2.6-2). Table 2.6-27 summarizes results from the latest sampling of these wells. Relevant water quality parameters for wells deeper than 200 feet are summarized and compared to regional data in Table 2.6-28.

The Floridan Aquifer water in wells at the Swift Creek site and in other wells in the area is characterized by a pH generally between 7.0 and 8.0, a hardness ranging from 120 to 350 ppm as CaCO_3 , and dissolved solids less than 500 mg/l. Occidental supply wells tapping the Floridan Aquifer (at the Swift Creek Beneficiation Plant) had orthophosphate levels ranging from 0.08 to 0.36 mg P/l. Concentrations of iron in the supply wells ranged from 0.06 to 1.1 mg/l and about half the values are above the drinking water standard of 0.3 mg/l. All but one manganese analysis were below the drinking water standard of 0.05 mg/l. Concentrations of arsenic are below the detection level (0.02 mg/l), and other heavy metals are low to undetectable.

At great depths, the Floridan Aquifer contains saline water that is more mineralized than at shallower levels. The thickness of the potable water varies, but is estimated to range from 1000 to 2000 feet (Klein, 1975). Miller et al (1977) did not delineate the depth to the base of

the potable water but indicated that sulfate concentrations increase with depth. On one occasion, one analysis of an 800-foot deep well (SC-1) gave a sulfate level of 127 mg/l, but earlier and more recent values were much lower (28 to 48 mg/l), precluding the possibility of upconing of the more mineralized zone. Even the higher concentration is still within the range observed in regional data (see data on Jasper Well in Table 2.6-28) and considerably below the EPA Recommended Criterion of 250 mg/l.

2.6.6 WATER USES AND ISSUES

2.6.1.1 Water Supply

The proposed Swift Creek Chemical Complex of Occidental Chemical Company lies in Hamilton County, Florida within the upper reach of the Suwannee River Basin which is under the jurisdiction of the Suwannee River Water Management District.

The Suwannee River drains an area of approximately 10,000 square miles extending from the Okefenokee Swamp in southern Georgia to the Gulf area of Florida. Flow in the Suwannee River increases rapidly from an

average of 1,180 MGD at the Florida-Georgia state line to 11,000 MDG at its mouth because of the contribution from numerous springs and tributaries. Swift Creek, a tributary to the Suwannee River, drains the Swift Creek Swamp which in turn drains the Occidental Chemical Company properties.

Direct surface water withdrawals comprise only a small part of the source of water supply in Hamilton County. By far the principal source of water for industrial, municipal, agricultural and domestic uses in Hamilton County and in the Suwannee River Water Management District comes from groundwater. Three aquifers exist in the District: (1) the "surficial aquifer" which is generally less than 50 feet thick, (2) the "secondary artesian aquifer" which, in some areas, approaches 100 feet in thickness, and (3) the "Floridan Aquifer" averaging more than 1,000 feet in thickness in Hamilton County.

The surficial and secondary artesian aquifers are sources of water supply for small domestic, stock and some agricultural uses. The Floridan Aquifer is the principal source of groundwater in Hamilton County as well as in the district as a whole.

2.6.6.2 Water Uses

Water use in Hamilton County (as determined from a water use inventory conducted by the Water Resources Division of the USGS in late 1975 - early 1976) is summarized in Table 2.6-29. The water-use which reflects the socio-economic patterns is subdivided into the following categories: municipal, rural, irrigation and industrial.

Municipal supply systems use only groundwater as a source and include incorporated cities and towns as well as unincorporated small communities having a central supply system. All other residents are counted as rural domestic users. These users also pump groundwater as the only source of domestic supply at an estimated rate of 100 gallons per day per person (SRWMD, 1977). Livestock water consumption which uses both surface and groundwater sources is included in the rural water use category.

Water supply for irrigation purposes are based on rough and not very reliable estimates. The ratio of groundwater pumping to surface water withdrawals as a source of supply for irrigation is approximately nine to one.

The main industrial user in Hamilton County is Occidental Chemical Company whose withdrawals consist of approximately 30 MGD pumped from groundwater sources only. Occidental Chemical Company also recycles approximately 205 MGD of water within its hydraulic systems. Occidental does not withdraw any water directly from surface streams or natural lakes. Evaporation losses in the settling ponds are more than replenished by precipitation. No power plants exist in Hamilton County and, therefore, there are no withdrawals for thermo-electric power generation.

In 1975-1976 direct withdrawals of water in Hamilton County amounted to about 33 MGD, of which approximately 99 percent was from groundwater sources. The phosphate industry consumptively used approximately 92 percent of all groundwater withdrawn in Hamilton County. Other major groundwater users in the area are shown in Figure 2.6-27.

A well inventory was conducted on properties owned by or leased to Occidental Chemical Company. The location of existing wells and relevant information for each well are presented in Appendix A2.6.3 which also presents major wells in the three-county area of Columbia, Hamilton, and Suwannee.

Water uses in the three-county area are summarized in Table 2.6-30. Municipal users account for only 3.4 MGD, the lowest volume of all categories, and use primarily groundwater from the Floridan Aquifer as a source of water supply. Rural domestic and livestock uses are estimated from typical per capita rates at about 4.1 MGD. Agricultural consumption for irrigation ranks third in volume at about 14.9 MGD.

Self-supplied industry and thermo-electric power are by far the heaviest water users in the region. The number of these users is low but their combined consumptive use equals approximately 35.6 MGD in the three-county area. This figure does not include recycled water which is not actually consumed and which may be returned to the same source or other sources from which it originated. The two main users in the three-county area are Occidental Chemical Company which recycles approximately 305 MGD of water wholly within its hydraulic systems, and a thermo-electric power plant in Suwannee County, the main user of surface water in the three-county area, whose usage includes approximately 172 MGD of surface water withdrawn then returned to the source, heated to some extent, but otherwise unaltered in quality. The recycled water which is returned to the same or other sources may change in quality although not necessarily to such an extent as to make it unusable for other beneficial purposes.

The above usage figures are for the most part estimates based on limited inventory data collected by the US Geological Survey, the Soil Conservation Service, and the Suwannee River Water Management District. The need for additional, more detailed information, has been recognized and a cooperative water use inventory is planned for the spring of 1978. The amounts of water currently used in the District comprise, however, only a fraction of the available water resources in the area. At the present time, no deep well injection system for replenishing the Floridan Aquifer exists in Hamilton County nor in the entire Suwannee River Water Management District.

Population projections are presented in Section 2.8. In the year 2000, an estimated 3,200 new domestic users will be added to the Hamilton County community and about 25,800 new users will be added to the three-county area. These new users will increase withdrawals by about 0.32 MGD in Hamilton County and about 2.58 MGD in the three-county area.

2.6.6.3 Water Quality and Quantity Issues

Regional water quality assessment is somewhat hampered by the lack of baseline data available in the three-county area. To date, no agency designation, nor funding has been made to prepare a water quality plan

under Federal "208" regulations. Very limited information was collected by the North Central Florida Regional Planning Council as part of a "201" study in the region. Most of this work centered on the more urbanized areas around Lake City. Some preliminary water quality issues were addressed by the "303" Basin Plan prepared by the Florida Department of Environmental Regulation.

Both point and non-point pollution sources are significant in the area. The following information considers only the estimates of the volume of discharge with no detail available on the nature and loading rates of individual parameters.

The discharge of municipal domestic waste represents a relatively low volume point source at the present time. However, this category is one which will increase as population centers grow. It also represents a difficult source to manage since loadings and types of pollutants can change with time. At present, the major municipal point sources are the City of Jasper, 0.3 MGD; the City of Live Oak, 0.4 MGD; and Lake City, 2.0 MGD.

Industrial point source discharges are fewer in number but perhaps more significant in terms of volumes produced. Industrial discharges, however,

are generally more uniform in parameters and in loadings. The entire water usage of 172 MGD of the thermo-electric plant near Live Oak may be considered a point source discharge. The discharge volumes and characteristics from Occidental Chemical Company are discussed in detail in other sections of this report.

Non-point sources in the three-county area are very significant since much of the local economy is agriculturally oriented. Documentation of such sources is very difficult because of the rural nature of the area.

The livestock industry, especially poultry, and agriculture account for the major volumes of non-point source discharges. Another very large non-point source is the silviculture industry in the area. The potential for increasing pollution problems in these areas is very high. The increased use of fertilizers, pesticides and other supplementary materials as well as land alterations associated with these activities will represent a continuing water quality problem.

TABLE 2.6-1

FLOW PARAMETERS OF SUWANNEE RIVER AND PRINCIPAL TRIBUTARIES

USGS Station Number	Location	River Mile†	Drainage Area* Sq Mi	Central Values (cfs)			Low Flows (cfs)**				Peak Flows (cfs) ***			
				Average Flow	Median Yearly	Median Daily	M7.2	M7.10	M30.2	M30.10	Q2	Q5	Q25	Q100
02314500	Suwannee River at Fargo Georgia	222	1200	1104	1024	195	69	1.2	110	3.2	4270	8020	14800	20900
	Suwannee River above Rocky Creek	199.4	2015	1640	1440	430	23	1.5	65	4	7570	13400	21700	22600
02314986	Rocky Creek near Belmont, Florida	199.1	71.0	31	20		.02-.04	0	0.6-.7	0	855	1620	3530	5900
	Rocky Creek at mouth	199.1	71.6	31	20		.04-.05	0	0.8-1.0	0	922	1690	3680	6150
02315000	Suwannee River near Benton, Florida	196.5	2090	1670	1460	440e	23e	1.5e	66	4	7670	13600	20000	27800
02315500	Suwannee River at White Springs, Florida	171.8	2430	1879	1599	500	54.6	9.9	97	15.4	8130	14400	23300	29400
	Suwannee River above Swift Creek	162.8	2490	1935e	1710e	550e	80e	22e	130e	30e	8200	14500	23500	29700
02315520	Swift Creek at Facit, Florida	162.8	37.9	31	23	8	1 - 2	0 - .2	2 - 3	.3 - .5	710	1300	2840	4740
	Swift Creek at mouth	162.8	41.9	35	26	10	4 - 5	0 - .4	4 - 6	.5 - .7	836	1530	3340	5280
02315550	Suwannee River at Suwannee Springs, Fla.	150.3	2630	2020	1795	650e	144e	65e	200e	78e	8370	14800	24000	30300
	Suwannee River above Alapaha River	134.8	2690	2500e	1840e	1300e	300e	150e	400e	200e	9500e			
02317500	Alapaha River near Statenville, Georgia	138.4	1400	1032	912	360	50	25	62	30	5060	9110	16700	24200
	Alapaha River at mouth	138.4	1840	800+300	--	--	0	0	0	0	5060e			
	Suwannee River above Withlacoochee River	127.2	4610	4600e	4200e	3600e	1370e	910e	1620e	940e	12000e			
0231900	Withlacoochee River at Pinetta, Florida	127.2	2120	1666	1444	600	139	89.2	150	96	9320	19000	40700	65700
	Withlacoochee River at mouth	127.2	2360	1900e	1650e	680e	155e	100e	130e	110e	9700e			
02319500	Suwannee River at Ellaville, Florida	127.0	6970	6548	5843	4300	1530	1010	1870	1050	18300	33000	61400	90100
02320000	Suwannee River at Luraville, Florida	98.0	7330	6670e	6140e	4600e	2030	1360	2320	1400	17000			
02320500	Suwannee River at Branford, Florida	76.0	7880	6960	6363	4900	2367	1673	2770	1770	16200	27500	48100	68300
	Suwannee River above Santa Fe River	65.7	7970	7120	6500e		2600e	1900e	3070e	2000e	15000e			
02322500	Santa Fe River at Ft. White, Florida	65.7	1017	1637	1477	1170	959	716	1020	754	4240	7100	12200	16900
	Santa Fe River at mouth	65.7	1380	2300	2000e		1300e	1000e	1400e	1100e	4800			
02323500	Suwannee River near Wilcox, Florida	33.5	9640	9980f	9100e	7500e	4970	3682	5400e	4200e	17100	27600	46500	64900

†Based on Corps of Engineers

*Areas of the Suwannee River are all approximate because of indeterminate area of Okefenokee Swamp at its origin.

Adjusted to equivalent 46-year average including 1932-41.

**The first numeral refers to the duration in days, the second to the recurrence interval in years. For example, M7.10 is the 7-day flow to which flows will recede once in 10 years.

***The numeral refers to the recurrence interval in years. For example, Q25 is the peak flow which has a probability of occurrence once every 25 years, i.e., flows equal to or larger than this flow will occur on the average once every 25 years.

TABLE 2.6-2

DISCHARGE MEASUREMENTS, SWIFT CREEK AT FACIL, STATION 02315520

Miscellaneous Discharge Measurements, Q(cfs)/Date											
Water Year	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	SEP
1969											
1970	29/14		139/11		89/2		248/8	32/25			
1971	25/6		12/9		17/4		15/27		11/23		
1972	17/7		44/7		124/14		37/25		1180/27		
1973		19/15			65/7		933/3		47/5		
1974	17/3		9.8/6		16/12		42/3		10/11		
1975	36/8		14/4		65/5	41/31			62/2		
1976			8.9/8		106/2		65/5	237/25			
Daily Streamflow Records in cfs, 1976 - 1977											
1976 max								237	53	64	93
ave								-	28.6	33.8	50.4
min								-	10	6.0	7.4
1977 max	82	166	197	306	176	165	92	57	49	45	83
ave	50.8	59.5	141	145	90	93.7	45.6	16.8	27.5	26.4	64.5
min	23	1.7	81	82	45	47	19	3.6	18	3.8	50

Maximum Measured
Minimum Measured
Maximum Daily
Minimum Daily

1969 - 1976
1969 - 1976

May 1976 to September 1977
May 1976 to September 1977

1180 cfs on June 27, 1972
8.9 cfs on December 8, 1976
306 cfs on January 4, 1977
1.7 cfs on November 11, 1976

Overall Maximum to Minimum Range - 1180 to 1.7 cfs

TABLE 2.6-3

ESTIMATED AVERAGE FLOW AT SWIFT CREEK MONITORING SITES

<u>Monitoring Site</u>	<u>River Mile</u>	<u>Location</u>	<u>Drainage Area (sq. miles)</u>	<u>Average Flows (cfs) $\pm$ 10%</u>	
				<u>Natural Conditions</u>	<u>Present Conditions</u>
SC 9	6.55	Wooden Bridge	24.4	14.6	10
SC 7.5	5.40	Southern Railraod	28.5	20	44
SC 7	5.33	Wooden Bridge (NPDES No. 001)	31.0	22	46
SC 6	4.10	Sampling Site	35.4	27	51
SC 4	2.62	USGS Gauge No. 02315520 at US 41 bridge	37.9	31	55
SC 1	0.00	Mouth at Suwannee River	41.9	35	59

TABLE 2.6-4

USGS GAUGING STATIONS USED TO EVALUATE COEFFICIENTS AND
PARAMETER EXPONENTS IN FLOOD FREQUENCY RELATIONSHIP

<u>Station No.</u>	<u>Name</u>
02228500	North Prong St. Marys River at Moniac, Georgia
02229000	Middle Prong St. Marys River at Taylor, Florida
02230000	Turkey Creek at Macclenny, Florida
02230500	South Prong St. Marys River at Glen St. Mary, Florida
02245500	South Fork Black Creek near Penney Farms, Florida
02246000	North Fork Black Creek near Middleburg, Florida
02314500	Suwannee River at Fargo, Georgia
02315500	Suwannee River at White Springs, Florida
02319500	Suwannee River at Ellaville, Florida
02321000	New River near Lake Butler, Florida
02321500	Santa Fe River at Worthington Springs, Florida
02321700	Swift Creek near Lake Butler, Florida
02321800	Olustee Creek near Providence, Florida
02324400	Fenholloway River near Foley, Florida
02324500	Fenholloway River at Foley, Florida
02326000	Econfina River near Perry, Florida
02326500	Aucilla River at Lamont, Florida
02328000	Tired Creek near Cairo, Georgia
02329500	Little River near Quincy, Florida
02330100	Telogia Creek near Bristol, Florida

TABLE 2.6-5
SWIFT CREEK FLOOD DISCHARGES BY
REGIONAL REGRESSION RELATIONSHIP

Cross-Section Designation	River Miles Above Mouth	Location	Peak Discharge* (cfs)				
			Q ₂	Q ₅	Q ₂₅	Q ₅₀	Q ₁₀₀
PRIOR TO DEVELOPMENT:							
8A	7.28	SW corner of Section 3, T.1S, R.15E	355	649	1420	1850	2370
6	6.27	East Side of NE 1/4 of Section 10	373	682	1490	1940	2490
4	5.49	Center of NW 1/4 of Section 14	524	939	2090	2730	3500
3	4.40	Southwest Edge of Section 14	606	1110	2420	3160	4040
1B	2.60	USGS Gauge 02315520	729	1330	2910	3800	4860
BASED ON FLOW BELOW BERM ONLY:							
6	6.27	East Side of NE 1/4 of Section 10	122	222	485	635	811
4	5.49	Center of NW 1/4 of Section 14	285	522	1140	1490	1900
3	4.40	Southwest Edge of Section 14	388	710	1550	2025	2590
1B	2.60	USGS Gauge 02315520	530	969	2120	2765	3530

*The numeral refers to the recurrence interval in years. For example, Q₂₅ is the peak flow which has a probability of occurrence once every 25 years.

TABLE 2.6-6

RESULTS OF FLOOD ROUTING STUDY IN SWIFT CREEK SWAMP

<u>ORIGINAL CONDITION OF SWIFT CREEK SWAMP AND NATURAL CHANNEL</u>	<u>Flood Recurrence Interval, years</u>				
	<u>2</u>	<u>5</u>	<u>25</u>	<u>50</u>	<u>100</u>
Peak Outflow, cfs	237	410	807	1015	1254
Maximum Flood Elevation in Swamp, ft(MSL)	121.7	122.2	123.1	123.5	123.8
 <u>DREDGED CHANNEL WITH BERM AND OUTLET STRUCTURE SET AT EL. 113 FT(MSL)</u>					
Peak Outflow, cfs	491*	537	594	624	659
Maximum Flood Elevation Above Berm, ft(MSL)	121.4	122.0	123.1	123.5	123.9

*This flow which is higher than that predicted by the regression equation was not used. (A value of 355 cfs from the regression equation was used). Further adjustment is not appropriate considering the minimal definition of the topography in Swift Creek Swamp.

TABLE 2.6-7

SWIFT CREEK FLOOD DISCHARGES

BASED ON REGIONAL REGRESSION RELATION AND FLOOD ROUTING THROUGH SWIFT CREEK SWAMP

Cross-Section Designation	River Miles Above Mouth	Location	Peak Discharge *(cfs)				
			<u>Q₂</u>	<u>Q₅</u>	<u>Q₂₅</u>	<u>Q₅₀</u>	<u>Q₁₀₀</u>
PRIOR TO DEVELOPMENT:							
8A	7.28	SW corner of Section 3, T. 1S, R. 15E	237	410	807	1015	1254
6	6.27	East Side of NE 1/4 of Section 10	307	538	1085	1378	1720
4	5.49	Center of NW 1/4 of Section 14	464	816	1712	2200	2769
3	4.40	Southwest Edge of Section 14	557	996	2082	2683	3384
1B	2.60	USGS Gauge 02315520	689	1235	2612	3378	4264
CHANNELIZED STREAM WITH BERM IN PLACE:							
8A	7.28	SW corner of Section 3, T. 1S, R. 15E	355	537	594	624	659
6	6.27	East Side of NE 1/4 of Section 10	373	626	872	987	1125
4	5.49	Center of NW 1/4 of Section 14	472	882	1500	1809	2174
3	4.40	Southwest Edge of Section 14	606	1054	1869	2292	2789
1B	2.60	USGS Gauge 02315520	729	1270	2399	2982	3669

*The numeral refers to the recurrence interval in years. For example, Q_{25} is the peak flow which has a probability of occurrence once every 25 years.

TABLE 2.6-8

WATER LEVEL ELEVATIONS
IN SELECTED OBSERVATION WELLS THROUGHOUT THE SITE

Observation Well	Elevation Ground Surface ft. (MSL)	Interval Monitored ft. (MSL)	Water Level Elevation ft. (MSL)									
			12/6/77	12/13-14/77	1/16/78	1/20-24/78	2/7-8/78	2/22-24/78	3/9/78	3/17/78	3/28/78	4/11-19/78
SWIFT CREEK SITE:												
Set 1	1A	141.5 ~ 137.5	139.5	138.9	139.7	139.7	-39.6	140.0	141.56	141.07	140.21	139.70
	1AA	141.4 ~ 128.4	138.8	138.9	139.4	-	-	139.7	140.72	140.65	140.21	139.09
	1B	142.65 ~ 106.6	138.9	139.0	139.4	-	-	139.2	140.75	140.68	139.55	139.15
	1C	52.9 ~ 22.9	-	-	-	-	68.0	55.9	55.75	57.80	58.37	54.42
Set 2	2A	142.0 ~ 136.0	139.5	139.1	140.4	140.4	140.5	141.2	142.26	140.92	140.38	139.54
	2B	117.0 ~ 105.0	138.8	139.7	139.8	139.8	-	139.5	141.03	140.99	139.71	139.15
	2C	38.0 ~ 14.0	-	-	-	-	53.9	54.8	54.7	56.69	57.46	53.69
	Set 3	145.2 ~ 136.2	139.6	140.7	139.5	139.5	139.6	139.1	139.64	139.63	138.89	138.77
Set 3	3B	109.3 ~ 98.3	138.3	138.3	139.6	139.6	-	140.2	140.59	140.75	139.86	138.65
	3C	43.1 ~ 26.1	-	-	-	-	-	63.9	62.23	63.77	63.92	59.77
	3D	6.1 ~ -9.9	-	-	-	-	-	58.1	56.88	58.95	59.39	55.24
	3E	-96.9 ~ -153.9	-	-	-	-	-	54.7	54.44	56.53	57.04	52.26
	Set 4	143.3 ~ 133.3	140.3	140.3	140.1	142.2	140.6	140.8	140.94	140.84	139.77	139.33
Set 4	4B	112.3 ~ 100.3	138.3	138.3	139.4	139.4	-	140.3	140.34	140.51	139.72	138.72
	4C	81.1 ~ 70.1	-	-	-	-	137.8	139.4	139.73	138.93	138.95	137.59
	SUMANNEE RIVER SITE:											
	Set 1	1A	128.6 ~ 118.6	-	-	126.7	127.3	126.4	125.9	126.28	126.35	125.80
Set 1	1B	116.6 ~ 91.6	-	-	126.9	127.4	-	126.9	127.03	127.38	126.75	126.21
	1C	23.0 ~ 1.0	-	-	-	-	69.7	65.1	64.65	66.33	66.64	62.46
	Set 2	2A	136.3 ~ 125.3	-	-	127.0	127.4	127.2	127.19	127.21	126.90	126.06
	2B	118.2 ~ 89.2	-	-	127.5	128.0	-	127.7	128.10	128.20	127.62	127.19
Set 2	2C	20.5 ~ -6.5	-	-	-	-	86.2	87.0	67.50	69.33	69.55	65.72
	Set 3	125.4 ~ 115.4	-	-	-	125.3	-	126.2	126.68	126.94	126.34	126.27
	3B	103.5 ~ 83.5	-	-	-	124.6	-	124.9	126.42	126.54	125.94	126.00
	3C	54.8 ~ 38.8	-	-	-	70.0	-	66.8	68.39	69.75	70.41	67.22
Set 3	3D	33.5 ~ 6.5	-	-	-	-	61.6	65.3	65.25	66.89	67.35	64.41
	Set 4	124.4 ~ 107.4	-	-	-	124.2	-	-	123.72	122.52	122.80	121.66
	4B	105.6 ~ 83.6	-	-	-	-	122.3	-	123.34	122.23	122.61	121.51
	4C	43.4 ~ 27.4	-	-	-	76.4	-	-	71.48	73.00	73.18	69.93
Set 4	4D	20.2 ~ -3.8	-	-	-	-	66.0	-	62.95	64.85	64.90	61.65
	Set 5	124.4 ~ 111.4	-	120.9	-	121.3	-	120.7	121.64	121.41	120.71	120.63
	5B	108.8 ~ 85.8	-	-	-	118.7	-	120.5	121.11	121.15	120.74	120.09
	5C	64.9 ~ 44.9	-	118.4	-	120.3	-	112.5	108.72	109.19	108.96	107.78
	5D	29.7 ~ 5.7	-	-	-	-	93.1	93.8	87.33	88.75	88.77	86.83
Set 5	6A	126.5 ~ 116.5	-	123.6	-	121.6	-	121.1	123.64	123.54	123.91	123.96
	6B	109.9 ~ 81.9	-	-	-	122.6	-	122.6	122.96	123.05	122.89	124.02
	6C	56.4 ~ 45.4	-	63.4	-	70.9	-	67.4	66.97	68.62	68.58	65.25
	6D	32.1 ~ 2.1	-	-	-	-	56.6	57.3	58.05	59.54	59.16	54.67

TABLE 2.6-9

CURRENT WITHDRAWALS FROM THE FLORIDAN AQUIFER
BY EXISTING OCCIDENTAL CHEMICAL COMPANY OPERATIONS

Industrial Wells:

	Well No.		Depth of Well (ft)	Design Well Capacity (gpm)	Withdrawals (MGD)	Operation days/year
	OXY	EIS†				
Suwannee River Chemical Plant	C1	96	803	5000	12.00	310
	C2	97	700	5000*		
	C3	96A	800	5000		
Suwannee River Mine	M1	88	1265	7200	10.15	365
	M2	89	700	1700		
	M3	87	804	6600		
Swift Creek Mine	SC1	94	800	7000	9.67	365
	SC2	93	800	7000		

Potable Wells:

	Well No.		Depth of Well (ft)	Withdrawals (gpm)
	OXY	EIS		
Suwannee River Chemical Plant	CD1	95	315	200
	CD2	98	248	250
Suwannee River Mine	MD1	91	115-201	200
	MD2	90	190	60
	MST	78	240	60
	MAB	76	160	?
Swift Creek Mine	SCD1	92	270	200
	SCD2	91A	75	30

*This well is a spare.

†See Appendix A2.6.3.

Table 2.6-10 Criteria for Class III Streams.

Parameter	DER, Chapter 17-3 Florida Administrative Code
Arsenic	0.05 mg/l
B.O.D.	Not exceed values to cause D.O. to be depressed below class criteria, nor to produce nuisance conditions
Chloride	250 mg/l
Chromium	0.05 mg/l after reasonable mixing in stream; (0.5 mg/l hexavalent or 1.0 mg/l total in effluent)
Copper	0.5 mg/l
Cyanide	None Detectable
Detergents	0.5 mg/l
Dissolved Oxygen	Not less than 5 mg/l average daily; never less than 4 mg/l except if background indicates lower limits
Fluoride	10 mg/l
Iron	0.3 mg/l
Lead	0.05 mg/l
Mercury	None Detectable (in discharge)
Oil and Grease	Not more than 15 mg/l nor to cause taste and odors or interfere with beneficial uses
pH*	6.0 - 8.5 except if background is outside these limits; and not more than 1.0 unit variation from normal
Phenols	0.001 mg/l
Solids (Dissolved)	1000 mg/l (with monthly mean less than 500 mg/l)
Specific Conductance	Not increased more than 100% above background or a maximum of 500 μ mhos/cm in freshwater streams
Turbidity	Not exceed 50 NTU above background
Zinc	1.0 mg/l

Table 2.6-11 Means and ranges of values obtained from USGS samplings via the EPA SIURET system.

STATIONS															
	Benton #02315000			White Springs #02315500			Sowannee Springs #02315550			Branford #02320500			Willcox #02323500		
Total Alkalinity	mean 1.56 min. 0 max. 8.0	mean 5.71 min. 0 max. 29	mean 34.86 min. 2 max. 78	mean 98.70 min. 0 max. 157	mean 116.3 min. 33 max. 148										
Dissolved Calcium	mean 1.87 min. .8 max. 3.8	mean 3.16 min. 1.3 max. 9.1	mean 15.69 min. 4.3 max. 32	mean 34.37 min. 3.3 max. 57	mean 41.91 min. 14 max. 53										
Chloride	mean 6.87 min. 4.1 max. 9.8	mean 6.37 min. 4 max. 10	mean 7.76 min. 4.8 max. 11	mean 6.35 min. 2.8 max. 15	mean 7.65 min. 5 max. 15										
Total Iron	mean 547.5 min. 420 max. 770	mean 571.81 min. 410 max. 950	mean 586.25 min. 370 max. 940	mean 474.70 min. 70 max. 790	mean 508.57 min. 240 max. 810										
Dissolved Fluoride	mean 0.22 min. 0 max. .4	mean 0.25 min. 0 max. .5	mean 0.51 min. 0 max. 2	mean 0.27 min. 0 max. .7	mean 0.25 min. 0 max. .5										
Total Hardness	mean 8.67 min. .4 max. 18.0	mean 14.23 min. 6 max. 38	mean 53.37 min. 14 max. 110	mean 114.04 min. 12 max. 178	mean 129.81 min. 42 max. 164										
Dissolved Potassium	mean 0.31 min. .2 max. .7	mean 0.30 min. 0 max. 1	mean 0.44 min. .2 max. 1.1	mean 0.52 min. 0 max. 1.2	mean 0.57 min. .3 max. 2										
Dissolved Sodium	mean 3.71 min. 2.4 max. 5.4	mean 3.26 min. 2.3 max. 5.4	mean 4.81 min. 2.7 max. 8.8	mean 4.35 min. 1.3 max. 7.3	mean 6.73 min. 2.9 max. 28										
Total Nitrogen as N	mean .434 min. .19 max. .94	mean .231 min. .04 max. .62	mean .424 min. .073 max. 1.46	mean .251 min. 0.35 max. .57	mean .183 min. .03 max. .33										
Nitrogen (Ammonium)	mean .19 min. .19 max. .19	mean .122 min. 0 max. .23	mean .243 min. .11 max. 1.4	mean .14 min. .14 max. .14	mean 0 min. 0 max. 0										
Nitrogen (Nitrite and Nitrate)	mean .678 min. .37 max. .94	mean .73 min. .16 max. 1.4	mean .32* min. 0 max. 1.5*	mean .38 min. 0 max. .75	mean .367 min. 0 max. .59										
Nitrogen (Organic)	mean .155 min. .15 max. .16	mean .416 min. .21 max. .95	mean 1.30 min. .37 max. 2.8	mean .44 min. 0 max. 1.8	mean .33 min. .15 max. .77										
Ortho-phosphate as P ₂ O ₅	mean .19 min. .13 max. .25	mean .163 min. .11 max. .31	mean 1.04 min. .120 max. 6.9	mean .217 min. .11 max. .6	mean .175 min. .11 max. .45										
Sulfate	mean 2.98 min. 0 max. 11	mean 3.77 min. 0 max. 10	mean 11.7 min. 1.2 max. 30	mean 14.34 min. 0 max. 24	mean 15.98 min. 4.8 max. 20										
Specific Conductivity	mean 47.42 min. 33 max. 61	mean 48.6 min. 30 max. 90	mean 103.8 min. 32 max. 370	mean 228.79 min. 28 max. 382	mean 217.19 min. 43 max. 360										
Total Organic Carbon	mean 33.53 min. 27 max. 45	mean 33.88 min. 14 max. 63	mean 26.85 min. 9 max. 44	mean 14.14 min. 0 max. 32	mean 11.01 min. 0 max. 23										
Total Zinc	mean 85 min. 0 max. 170	mean 85 min. 0 max. 170	mean 5 min. 0 max. 10	mean 22.23 min. 0 max. 100	mean 40 min. 10 max. 70										

Table 2.6-11 (Continued)

Parameter	S T A T I O N S					
	Rocky Creek #02314986		Swift Creek #02315500		Hunter Creek #02315005	
Total Alkalinity	min. 0.0	mean 4.38 max. 39.0	min. 0.0	mean 11.31 max. 69.0	min. 5.0	mean 30.38 max. 60.0
Dissolved Calcium	min. 1.5	mean 3.94 max. 9.7	min. 22.0	mean 45.30 max. 80.0	min. 6.6	mean 18.9 max. 49.0
Chloride	min. 5.5	mean 7.72 max. 11.0	min. 4.0	mean 17.52 max. 32.0	min. 4.0	mean 8.35 max. 12.0
Total Iron	min. 300	mean 726.0 max. 1200	min. 190	mean 599.2 max. 1000	min. 130	mean 528.6 max. 1200
Dissolved Fluoride	min. 0.0	mean 0.33 max. 0.64	min. 2.0	mean 6.63 max. 29.0	min. 0.2	mean 1.34 max. 2.80
Total Hardness	min. 8.0	mean 18.6 max. 49.0	min. 79.0	mean 170.5 max. 290.0	min. 30.0	mean 76.58 max. 190.0
Dissolved Potassium	min. 0.2	mean 0.44 max. 0.9	min. 1.1	mean 1.73 max. 2.6	min. 0.20	mean 0.75 max. 1.50
Dissolved Sodium	min. 3.0	mean 4.66 max. 7.9	min. 11.0	mean 28.70 max. 62.0	min. 2.5	mean 8.67 max. 20.0
Total Nitrogen as N	min. 0.39	mean 1.27 max. 4.46	min. 0.84	mean 8.97 max. 36.32	min. 0.49	mean 5.15 max. 21.28
Nitrogen (Ammonium)	min. 0.13	mean 0.15 max. 0.16	min. 0.57	mean 5.76 max. 23.0	min. 0.12	mean 3.21 max. 15.0
Nitrogen (Nitrite and Nitrate)	min. 0.00	mean 0.01 max. 0.03	min. 0.13	mean 1.06 max. 2.71	min.	mean max.

Table 2.6-11 (Continued)

Parameter	S T A T I O N S					
	Rocky Creek #02314986		Swift Creek #02315500		Hunter Creek #02315005	
Nitrogen (Organic)	mean 1.12	mean 1.1	mean 0.0	max. 7.9	mean 0.94	max. 2.5
Ortho-phosphate as PO ₄	min. 0.26	max. 4.30	min. 0.0	max. 7.9	min. 0.26	max. 2.5
Total Phosphate as P	mean 0.22	mean 42.5	mean 4.6	max. 130.0	mean 1.98	max. 0.48
	min. 0.12	max. 0.34	min. 4.6	max. 130.0	min. 0.95	max. 0.48
Sulfate	mean 0.18	mean 18.8	mean 1.5	max. 42.0	mean 1.30	max. 6.20
	min. 0.11	max. 0.30	min. 1.5	max. 42.0	min. 0.30	max. 6.20
Specific Conductivity	mean 11.1	mean 153.2	mean 69.0	max. 290.0	mean 44.24	max. 160.0
	min. 0.0	max. 20.0	min. 69.0	max. 290.0	min. 0.50	max. 160.0
Total Organic Carbon	mean 89.6	mean 467.4	mean 135.0	max. 870.0	mean 204.0	max. 630.0
	min. 0.0	max. 650.0	min. 135.0	max. 870.0	min. 9.0	max. 630.0
Total Zinc	mean 50.1	mean 19.4	mean 0.0	max. 44.0	mean 18.3	max. 45.0
	min. 4.0	max. 97.0	min. 0.0	max. 44.0	min. 6.0	max. 45.0
	mean 10.0	mean 15.0	mean 10.0	max. 20.0	mean 20.0	max. 30.0
	min. 10.0	max. 10.0	min. 10.0	max. 20.0	min. 10.0	max. 30.0

Table 2.6-12 Regression constants and statistical information for selected chemical parameters along the Suwannee River. 1

Station	Parameter	Slope(b)	Intercept(a)	Number of Observations	Correlation(r)	Significance ²
Rocky Creek at Mouth	Total P ₀ , as P	-0.21099	-0.95168	43	-0.85569	.00001
	NH ₃ Nitrogen	0.07153	-1.39250		0.34510	.02116
	NO ₂ Nitrogen	0.02387	-1.68546	40	0.14953	.20247
	NO ₃ Nitrogen	0.06107	-1.78655	11	0.33539	.18860
	Organic Nitrogen	0.06988	-0.05306		0.37532	.01012
	Fluoride	-0.03122	-0.47289	43	-0.24582	.07421
	SO ₄	0.00904	0.93747	14	0.02796	.46748
	TOC	0.10384	1.56383	43	0.44673	.00357
Suwannee River near Benton, FL.	Total P ₀ , as P	-0.37708	-0.21387	14	-0.92321	.00001
	NH ₃ Nitrogen	0.09829	-1.40193		0.14214	.23971
	NO ₂ Nitrogen	0.00450	-1.92814	22	0.02161	.46198
	NO ₃ Nitrogen	-0.00903	-1.45277	19	-0.01110	.48201
	Organic Nitrogen	-0.00132	-0.17633		-0.00900	.48730
	Fluoride	0.01694	-0.91173	20	0.06086	.41471
	SO ₄	-0.39563	1.99270	21	-0.46520	.02994
	TOC	-0.01703	1.57267	13	-0.19404	.26200
Suwannee River at White Springs, FL.	Total P ₀ , as P	-0.27085	-0.14425	45	-0.67830	.00001
	NH ₃ Nitrogen	0.00624	-0.93351		-0.00742	.47607
	NO ₂ Nitrogen	0.26436	-1.71740	52	-0.12660	.18557
	NO ₃ Nitrogen	-0.31348	-0.47023	54	-0.30106	.01348
	Organic Nitrogen	0.05332	-0.36586		0.13074	.21380
	Fluoride	0.06063	-0.50374	49	-0.18819	.05768
	SO ₄	-0.16647	1.19162	58	-0.17588	.09331
	TOC	0.10130	1.17761	38	0.21415	.09834
Swift Creek at Mouth	Total P ₀ , as P	-0.12018	1.41510	45	-0.21845	.07235
	NH ₃ Nitrogen	-0.16616	1.00385		-0.23078	.05532
	NO ₂ Nitrogen	-0.15261	-0.91420	52	-0.15372	.14326
	NO ₃ Nitrogen	-0.33712	0.64615	70	-0.37201	.00503
	Organic Nitrogen	0.12937	-0.31571		0.14594	.16383
	Fluoride	-0.11265	0.92468	69	-0.22960	.03631
	SO ₄	-0.23837	2.59916	46	-0.56938	.00018
	TOC	0.23666	0.86292	47	0.47626	.00041
Suwannee River at Suwannee Springs, FL.	Total P ₀ , as P	-0.55565	1.59707	39	-0.66944	.00001
	NH ₃ Nitrogen	-0.31769	0.20535		-0.37813	.00621
	NO ₂ Nitrogen	-0.15652	-1.24473	47	-0.33914	.01133
	NO ₃ Nitrogen	-0.99204	2.15199	45	-0.79413	.00001
	Organic Nitrogen	0.12723	-0.57704		0.25662	.02823
	Fluoride	-0.13591	0.03556	55	-0.24262	.04479
	SO ₄	-0.26617	1.89218	23	-0.32080	.09026
	TOC	0.19002	0.82087	23	0.62004	.00001

Table 2.6-12 (Continued)

Station	Parameter	Slope(b)	Intercept(a)	Number of Observations	Correlation(r)	Significance ²
Suwannee River at Branford, Fl.	Total PO ₄ as P	-0.22999	0.17628	78	-0.38450	.00028
	NH ₃ Nitrogen	0.43218	-3.03840		0.35600	.00086
	NO ₂ Nitrogen	0.23826	-2.80092	65	0.30068	.00747
	NO ₃ Nitrogen	-1.20098	3.93260	73	-0.65479	.00001
	Organic Nitrogen	0.60441	-2.74873		0.57720	.00001
	Fluoride	0.07342	-0.92002	267	0.10605	.04334
	SO ₄	-0.68136	3.55351	253	-0.75751	.00001
	TOC	0.56158	-1.06254	55	0.58394	.00001
Suwannee River near Wilcox, Fl.	Total PO ₄ as P	0.02818	-0.91736	47	0.02702	.43172
	NH ₃ Nitrogen	0.57094	-3.55147		0.21907	.04776
	NO ₂ Nitrogen	0.55014	-4.25519	44	0.32346	.01956
	NO ₃ Nitrogen	-1.75660	6.38839	64	-0.70033	.00001
	Organic Nitrogen	0.86576	-3.97034		0.44639	.00028
	Fluoride	-0.02020	-0.54584	55	-0.02388	.43130
	SO ₄	-0.92425	4.77791	37	-0.73530	.00001
	TOC	0.63985	-1.51613	53	0.46937	.00033

Table 2.6-13 Mean concentrations as predicted by regression analysis of USGS data.

Station	Total P			Total F			SO ₄			TOC		
	Q _a	m(7,2)	m(7,10)	Q _a	m(7,2)	m(7,10)	Q _a	m(7,2)	m(7,10)	Q _a	m(7,2)	m(7,10)
02315500 Suwannee River at White Springs	0.01	0.24	0.01	0.20	0.25	0.27	4.40	7.99	10.60	32.30	22.60	19.0
0215520 Swift Creek	16.10	17.70	17.70	5.35	5.85	5.87	153.00	185.00	186.00	18.80	15.60	15.50
Swift Creek at the Mouth	15.90	17.40	17.70	5.31	5.76	5.87	150.00	179.00	186.00	--	19.10	16.10
02315550 Suwannee River at Suwannee Springs	0.58	2.50	3.89	0.39	0.55	0.62	10.30	20.80	25.70	28.10	17.00	14.60
02317500 Alapaha River	0.10	0.31	0.39	0.16	0.22	0.24	1.78	2.18	2.22	15.70	7.11	5.93
02319000 Withla-coochee River	0.14	0.29	0.33	0.31	0.51	0.56	5.20	22.20	28.70	14.30	11.00	10.50
02320500 Suwannee River at Branford	0.20	0.25	0.27	0.23	0.21	0.21	8.64	18.00	22.80	12.50	6.81	5.40
02322500 Santa Fe River	0.08	--	--	(Insufficient data to perform regressions.)								
02323500 Suwannee River at Wilcox	0.16	0.15	0.15	0.24	0.24	0.24	12.00	23.00	30.03	10.90	7.01	5.83

Table 2.6-13 (Continued)

Station	Ammonia-Nitrogen			Organic Nitrogen			Nitrate-Nitrogen			Nitrite-Nitrogen		
	Q _a	m(7,2)	m(7,10)	Q _a	m(7,2)	m(7,10)	Q _a	m(7,2)	m(7,10)	Q _a	m(7,2)	m(7,10)
02315500 Suwannee River at White Springs	0.12	0.12	0.12	0.64	0.53	0.49	0.03	0.10	0.07	0.01	0.02	0.02
0215520 Swift Creek	5.18	5.91	5.95	0.81	0.73	0.73	1.15	1.50	1.51	0.07	0.08	0.08
Swift Creek at the Mouth	5.12	5.78	5.94	0.82	0.75	0.73	1.12	1.43	1.51	0.07	0.07	0.08
02315550 Suwannee River at Suwannee Springs	0.14	0.33	0.43	0.70	0.50	0.45	0.07	1.03	2.26	0.02	0.03	0.03
02317500 Alapaha River	0.05	0.17	0.23	(No samples available)								
02319000 Withlacoochee River	0.05	0.06	0.06	0.60	0.51	0.50	0.11	0.27	0.31	0.02	0.02	0.02
02320500 Suwannee River at Branford	0.04	0.03	0.02	0.38	0.20	0.16	0.21	0.76	1.15	0.01	0.01	0.01
02322500 Santa Fe River												
02323500 Suwannee River at Wilcox	0.05	0.04	0.03	0.31	0.17	0.13	0.23	0.79	1.33	0.01	0.01	0.01

Table 2.6-14 Ranges of Values Obtained in the Current Sampling Program of Streams.

Parameter	SC-1	SC-2	SC-3	SC-4	SC-5	SC-6	SC-7	ABC-8	SC-9	SC-9.5
Alkalinity as CaCO ₃	2.0-94.0	11.0-95.0	3.0-11.0	14.0-100.0	9.0-18.0	6.0-106.0	28.0-105.0	30.0-99.0	0.0-106.0	0.0-109.0
BOD	<1.0-1.4	<1.0-2.4	<1.0	1.0-2.6	<1.0	1.0-2.7	1.0-2.9	1.0-2.2	<1.0	<1.0
Calcium	47.0-70.0	47.0-68.0	7.8-10.8	45.5-73.6	7.8-9.5	44.0-69.0	44.0-62.0	43.0-75.0	14.0-32.0	12.0-21.0
Chloride	14.0-21.0	7.1-17.0	1.8-19.0	12.0-16.0	9.8-13.0	12.0-25.0	13.0-16.0	12.0-19.0	12.0-16.0	8.3-16.0
Chlorophyll	37.0-52.0	43.0-58.0	0.6-1.0	61.0-71.0	0.7-1.6	67.0-73.0	75.0-82.0	120.0-130.0	3.1-9.2	4.3-45.0
Color (APHA units)	15-110	7-110	25-200	15-130	5-120	15-110	15-110	5-18	65-400	50-400
Conductance (μmhos/cm)	530-700	550-750	104-195	600-650	48-140	380-780	335-650	650-777	172-433	171-335
Dissolved Oxygen	4.2-9.5	4.4-9.2	7.2-12.4	3.7-17.0	6.1-13.0	4.6-18.5	2.7-12.6	1.8-16.6	8.0-12.2	4.7-11.3
DOC	13.0-39.0	13.0-42.5	6.0-29.5	12.0-29.0	4.0-21.5	12.0-29.5	12.0-29.0	8.0-20.5	10.0-42.0	32.0-48.0
Flow (cfs)	19.7-40.1	25.0-41.0	<0.1-0.8	23.6-38.5	0.2-1.1	7.3-33.1	1.6-44.0	6.3-32.7	0.0-16.9	0.0-16.1
Fluoride	4.1-7.6	4.2-8.9	0.2-0.5	4.5-9.7	0.3-0.4	4.1-12.0	3.8-7.4	3.6-12.0	0.4-1.0	0.4-0.7
Total Hardness as CaCO ₃	183.0-290.0	184.0-290.0	8.9-37.0	2.6-292.0	27.0-34.0	95.0-243.0	174.0-288.0	171.0-345.0	63.0-129.0	55.0-136.0
Magnesium	16.0-23.0	16.0-23.0	1.6-2.3	14.9-23.0	1.8-2.2	15.1-23.0	15.6-22.0	15.3-28.0	6.8-12.0	6.1-13.0
Nitrogen	3.99-20.00	4.76-18.40	0.02-0.25	0.02-20.90	0.02-0.15	1.13-20.50	0.05-22.20	8.54-40.60	0.07-0.31	0.02-0.25
Ammonium	1.14-4.40	1.03-4.18	0.22-0.98	1.03-3.33	0.24-1.60	0.62-3.24	0.33-3.33	0.31-3.21	0.02-0.60	0.03-0.54
Nitrite + Nitrate	0.95-1.60	0.90-1.64	0.48-0.79	1.01-2.41	0.15-0.42	0.98-2.52	0.80-3.60	1.11-2.90	0.51-2.28	0.49-2.24
Organic										
Oil and Grease	<1	<1	<1	<1	<1	1-2	1-3	<1	<1	<1
pH	6.2-7.1	6.4-7.1	5.7-6.8	6.3-7.0	5.7-7.1	5.6-7.2	6.3-7.0	6.6-6.9	3.7-8.9	3.5-7.0
Phosphate as P										
Ortho	14.4-65.0	13.9-98.0	0.6-1.1	12.9-110.0	0.5-1.1	11.2-114.0	9.9-70.0	9.6-135.0	0.2-16.8	<0.1-14.5
Total	15.4-76.0	15.7-100.0	0.7-1.1	14.1-112.0	0.6-1.3	14.3-115.0	13.5-75.5	11.0-155.0	0.5-6.0	0.1-7.4
Potassium	1.6-2.0	1.6-2.0	0.7-1.0	1.6-1.9	0.2-0.7	1.6-2.0	1.6-1.9	1.6-2.6	0.2-0.4	0.4
Redox Potential (ORP)	+50-+250	+75-+200	+80-+270	-70-+280	-30-+260	+70-+290	+90-+280	-80-+260	+50-+225	+60-+350
Silica	17.0-50.0	17.4-42.0	6.9-10.4	15.8-36.0	6.8-9.8	15.1-53.0	25.6-64.0	26.8-78.0	13.7-24.0	16.0
Sodium	25.6-27.0	25.8-26.5	3.4-4.3	25.2-26.6	3.3-3.4	24.8-27.3	24.6-27.4	24.0-38.2	7.5-8.6	8.3
Solids (Dissolved)	248-768	418-794	34-120	414-716	10-118	366-764	360-736	350-882	164-236	146-242
Solids (Suspended)	4.0-14.0	1.0-16.0	1.0-14.0	2.0-26.0	1.0-18.0	1.0-38.0	1.0-29.0	1.0-63.0	6.0-122.0	6.2-103.0
Sulfate	156.0-310.0	152.0-380.0	3.9-11.0	153.0-548.0	4.0-8.6	154.0-570.0	24.0-350.0	28.3-550.0	15.3-75.0	15.0-75.0
Sulfide	<0.1-0.8	0.2-0.5	0.2-1.1	0.3-1.1	0.2-1.0	0.2-0.6	0.1-0.7	<0.1-0.6	0.4-1.1	0.4-1.5
Surfactants (MBAS)	0.001-0.045	0.013-0.051	0.011-0.062	0.018-0.05	0.010-0.034	0.008-0.041	0.02-0.034	0.022-0.051	0.008-0.025	0.002
Temperature °C	8.0-28.0	7.0-28.3	7.0-28.5	7.0-28.5	8.0-28.8	7.5-30.8	7.8-29.0	9.5-30.8	7.0-31.8	7.0-17.0
Turbidity (ntu)	1.5-8.0	0.9-7.5	0.9-1.8	0.7-8.0	0.1-1.8	1.1-10.0	1.5-20.0	1.2-42.0	1.0-32.0	1.5-42.0

* SC- Swift Creek station; SC1- Swift Creek tributary; ABC- Altman Bay Canal.
Range given is based on the sampling program conducted from July 1977 to February 1978.

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Table 2.6-14 (Continued)

Parameter	STATIONS*					
	SR-7	SR-8	RC-2	HC-1	RD-2	CB-1
Alkalinity as CaCO ₃	0.0-18.0	0.0-33.0	0.0-13.0	0.0-57.0	0.0-70.0	18.0-69.0
BOD	1.0	1.0	1.0	1.0	1.0	1.0
Calcium	1.4-5.4	3.2-16.0	1.4-3.5	22.0-23.5	4.6-12.0	11.0-15.0
Chloride	6.0-8.1	6.0-8.3	6.7-8.3	7.7-11.0	5.2-11.0	6.2-12.0
Chlorophyll	0.3-0.4	1.9-9.0	0.1-0.6	1.0-56.0	0.2-1.0	0.4-3.2
Color (ALPHA units)	200-270	180-270	270-420	25-200	15-400	25-240
Conductance (μmhos/cm)	48-105	40-188	72-120	90-242	68-340	70-150
Dissolved Oxygen	7.8-12.0	7.9-13.6	6.1-11.0	4.2-18.0	3.7-13.2	7.6-11.2
DOC	26.5-45.5	32.5-39.5	43.5-73.9	10.5-73.5	4.5-36.0	10.0-49.0
Flow (cfs)	365.0	212.0-305.0	0.1-35.4	1.2-12.6	-0.1-1.7	1.0-3.4
Fluoride	0.1-0.2	0.1-1.3	< 0.1-0.1	0.1-1.1	0.2-1.1	0.3-0.4
Total Hardness as CaCO ₃	7.0-20.0	13.0-62.0	7.7-27.0	93.0-97.0	22.0-49.0	48.0-70.0
Magnesium	0.9-1.9	1.2-5.3	1.0-3.4	9.1-9.3	2.6-4.7	5.0-7.9
Nitrogen						
Ammonium	0.02-0.35	0.08-3.96	0.02-0.34	0.02-0.56	0.02-1.15	0.02-0.21
Nitrite + Nitrate	0.01-0.04	0.01-0.50	0.01-0.02	0.04-0.82	0.06-0.60	0.01-0.97
Organic	0.49-0.72	0.52-0.94	0.38-2.03	0.22-1.68	0.06-1.65	0.11-2.20
Oil and Grease	<1	<1	<1	<1	<1	<1
pH	3.7-7.0	3.6-7.0	3.3-6.5	3.5-7.9	5.6-7.0	5.9-7.7
Phosphate as P						
Ortho	0.1-1.7	0.1-5.4	< 0.1-0.1	0.2-0.8	0.4-1.4	0.3-0.6
Total	0.1-1.8	0.1-6.3	0.1-0.2	0.2-0.9	0.5-1.6	0.4-0.9
Potassium	0.2	0.5	0.2	0.6	0.6	0.2
Redox Potential (ORP)	+90-+320	+18-+380	+120-+350	+85-+360	+50-+290	+115-+230
Silica	12.0	27.0	10.0	11.0	30.0	39.0
Sodium	3.3	8.3	4.2	9.9	3.3	5.0
Solids (Dissolved)	44-98	116-201	106-144	156-182	60-128	50-140
Solids (Suspended)	0.5-18.0	1.0-8.0	1.0-8.8	2.0-9.6	1.0-14.0	5.6-76.0
Sulfate	1.9-36.0	4.0-48.0	1.0-32.0	19.0-53.0	1.0-83.0	1.0-12.0
Sulfide	0.4-1.2	0.4-0.9	0.3-3.0	0.2-1.0	0.2-0.7	0.2-1.0
Surfactants (MBAS)	0.016	0.028	0.021	0.014	0.012	0.022
Temperature °C	6.5-18.0	6.0-18.0	6.8-17.0	7.0-17.5	8.8-17.5	7.8-16.0
Turbidity (NTU)	0.9-1.8	1.0-2.5	1.0-1.8	2.1-6.8	1.0-5.0	0.8-5.8

* SR= Suwannee River station; RC= Rocky Creek station; HC= Hunter Creek station; RD= Roaring Creek station; CB= Camps Branch station; Range given based on the sampling program conducted from July 1977 to February 1978.

Table 2.6-15 Chemical analyses of sediments from streams in the study area.*

Stations**	Date	pH	Percent Moisture	Ammonia N mg/g	Organic N mg/g	Total Phosphate-P mg/g	Sulfide mg/g
SC-1	July, 1977 Oct., 1977	7.2 7.0	21.7	0.0106 0.0052	0.180 0.085	0.785 1.100	0.0104 0.0007
SC-2	July, 1977 Oct., 1977	7.2 6.6	20.6	0.0031 0.0090	0.155 0.070	1.090 0.875	0.052 0.000
SCT-3	July, 1977 Oct., 1977	6.6 6.2	18.2	0.0013 0.0005	0.076 0.053	0.456 0.720	0.0008 0.0022
SC-4	July, 1977 Oct., 1977	7.0 7.0	26.0	0.0086 0.014	0.485 0.560	0.995 0.980	0.0113 0.096
SCT-5	July, 1977 Oct., 1977	6.6 6.4	21.5	0.0065 0.0028	0.180 0.057	2.930 0.865	0.0037 0.0008
SC-6	July, 1977 Oct., 1977	7.3 7.0	36.8	0.048 0.029	1.200 0.345	2.780 1.140	0.160 0.016
SC-7	July, 1977 Oct., 1977	7.2 7.0	41.4	0.087 0.132	1.200 0.150	2.200 7.140	0.170 0.400
ABC-1	July, 1977 Oct., 1977	6.7 7.6	20.2	0.072 0.044	0.280 0.225	5.400 0.840	0.032 0.010
SC-9	July, 1977 Oct., 1977	7.4 7.0	18.6	0.0050 0.0022	0.180 0.079	5.200 25.800	0.020 0.010
SC-9.5	Oct., 1977	6.6	23.4	0.0076	0.210	0.290	0.0010
SR-7	Oct., 1977	6.1	20.1	0.000	0.068	0.047	0.0002
SR-8	Oct., 1977	6.4	23.3	0.000	0.064	0.050	0.0003
RC-2	Oct., 1977	6.9	21.3	0.000	0.070	0.125	0.0002
RO-2	Oct., 1977	7.1	22.7	0.0063	0.170	0.665	0.0040
HC-1	Oct., 1977	6.9	23.1	0.0015	0.100	1.560	0.0010
CB-1	Oct., 1977	6.6	29.5	0.0046	0.235	5.250	0.0019
CB-2	Oct., 1977	6.7	26.1	0.0040	0.175	4.850	0.0018
CB-3	Oct., 1977	7.5	23.6	0.0029	0.275	4.850	0.0008

* Concentrations in mg/g (dry weight), except for % moisture, and pH which was measured on a 1:2.5 (sediment: distilled water) slurry.

** See Figure 2.3.3 for location of sampling stations.

Table 2.6-15 (Continued)

Station**	Date	Arsenic mg/g	Calcium mg/g	Chromium mg/g	Copper mg/g	Iron mg/g	Lead mg/g	Manganese mg/g	Mercury mg/g	Zinc mg/g
SC-1	July, 1977	B	B	0.0034	0.0020	0.473	0.0019	0.0116	A	0.0032
	Oct., 1977	B	0.00050	0.0020	0.0006	0.308	E	0.0078	A	0.0044
SC-2	July, 1977	B	B	0.0034	0.0006	0.377	0.0013	0.0089	A	0.0027
	Oct., 1977	B	0.00040	0.0021	C	0.189	E	0.0023	A	C
SCT-3	July, 1977	B	B	0.0021	C	0.172	0.0006	0.0070	A	0.0063
	Oct., 1977	B	0.00046	0.0018	0.0007	0.193	E	0.0046	A	C
SC-4	July, 1977	B	0.0002	0.0034	0.0006	0.581	0.0021	0.0136	A	0.0015
	Oct., 1977	B	0.00056	0.0030	0.0005	0.468	E	0.0126	A	0.0052
SCT-5	July, 1977	B	0.0002	0.0088	0.0015	1.280	0.0063	0.0267	A	0.0102
	Oct., 1977	B	0.00043	0.0020	C	0.311	E	0.0097	A	0.0040
SC-6	July, 1977	B	0.0008	0.0098	0.0018	2.550	0.0042	0.0187	A	0.0142
	Oct., 1977	0.0002	0.00060	0.0087	0.0008	1.340	0.0031	0.0072	A	0.0046
SC-7	July, 1977	B	0.0014	0.0243	0.0037	5.850	0.0067	0.0372	0.0004	0.0228
	Oct., 1977	0.0006	0.00142	0.0099	0.0019	2.200	0.0040	0.0026	A	0.0015
ABC-1	July, 1977	B	0.0005	0.0059	0.0009	1.400	0.0011	0.0217	A	0.0058
	Oct., 1977	B	0.00050	0.0012	0.0019	6.120	0.0070	0.0097	A	0.0034
SC-9	July, 1977	B	0.0004	0.0071	0.0013	1.970	0.0031	0.0581	A	0.0028
	Oct., 1977	0.0009	0.00069	0.0036	0.0016	1.700	E	0.0056	A	0.0029
SC-9.5	July, 1977	B	0.00039	0.0021	0.0006	0.408	E	0.0025	A	0.0021
SR-7	July, 1977	0.00042	0.00043	0.0004	0.0003	0.063	0.003	0.0007	0.0001	0.0009
SR-8	July, 1977	0.00040	0.00036	0.0004	0.0003	0.060	0.003	0.0006	0.0001	0.0008
RC-2	July, 1977	0.0005	0.00031	D	C	0.082	E	0.0007	A	0.0006
RO-2	July, 1977	0.00075	0.00066	0.0089	0.0016	0.440	F	0.0028	A	0.0094
HC-1	July, 1977	0.00065	0.00043	0.0019	0.0003	0.198	E	0.0029	A	0.0012
CR-1	July, 1977	0.00070	0.00045	0.0020	0.0003	0.728	0.003	0.0021	0.0001	0.0018
CB-2	July, 1977	0.00055	0.00099	0.0031	0.0006	0.506	0.003	0.0021	0.0001	0.0077
CB-3	July, 1977	0.00065	0.0013	0.0089	0.0014	1.410	0.003	0.0053	A	0.0099

** See Figure 2.3.1 for location of sampling stations.

Detection Limits: A, B, C, D, E, and F represent 0.0001, 0.0002, 0.0003, 0.0004, 0.0005, 0.0006, 0.0007, 0.0008, 0.0009, 0.001, 0.0012, 0.0015, 0.0018, 0.002, 0.0025, 0.003, 0.004, 0.005, 0.006, 0.007, 0.008, 0.009, 0.01, 0.012, 0.015, 0.018, 0.02, 0.025, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.12, 0.15, 0.18, 0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.5, 1.8, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 12.0, 15.0, 18.0, 20.0, 25.0, 30.0, 40.0, 50.0, 60.0, 70.0, 80.0, 90.0, 100.0, 120.0, 150.0, 180.0, 200.0, 250.0, 300.0, 400.0, 500.0, 600.0, 700.0, 800.0, 900.0, 1000.0, 1200.0, 1500.0, 1800.0, 2000.0, 2500.0, 3000.0, 4000.0, 5000.0, 6000.0, 7000.0, 8000.0, 9000.0, 10000.0, 12000.0, 15000.0, 18000.0, 20000.0, 25000.0, 30000.0, 40000.0, 50000.0, 60000.0, 70000.0, 80000.0, 90000.0, 100000.0, 120000.0, 150000.0, 180000.0, 200000.0, 250000.0, 300000.0, 400000.0, 500000.0, 600000.0, 700000.0, 800000.0, 900000.0, 1000000.0, 1200000.0, 1500000.0, 1800000.0, 2000000.0, 2500000.0, 3000000.0, 4000000.0, 5000000.0, 6000000.0, 7000000.0, 8000000.0, 9000000.0, 10000000.0, 12000000.0, 15000000.0, 18000000.0, 20000000.0, 25000000.0, 30000000.0, 40000000.0, 50000000.0, 60000000.0, 70000000.0, 80000000.0, 90000000.0, 100000000.0, 120000000.0, 150000000.0, 180000000.0, 200000000.0, 250000000.0, 300000000.0, 400000000.0, 500000000.0, 600000000.0, 700000000.0, 800000000.0, 900000000.0, 1000000000.0, 1200000000.0, 1500000000.0, 1800000000.0, 2000000000.0, 2500000000.0, 3000000000.0, 4000000000.0, 5000000000.0, 6000000000.0, 7000000000.0, 8000000000.0, 9000000000.0, 10000000000.0, 12000000000.0, 15000000000.0, 18000000000.0, 20000000000.0, 25000000000.0, 30000000000.0, 40000000000.0, 50000000000.0, 60000000000.0, 70000000000.0, 80000000000.0, 90000000000.0, 100000000000.0, 120000000000.0, 150000000000.0, 180000000000.0, 200000000000.0, 250000000000.0, 300000000000.0, 400000000000.0, 500000000000.0, 600000000000.0, 700000000000.0, 800000000000.0, 900000000000.0, 1000000000000.0, 1200000000000.0, 1500000000000.0, 1800000000000.0, 2000000000000.0, 2500000000000.0, 3000000000000.0, 4000000000000.0, 5000000000000.0, 6000000000000.0, 7000000000000.0, 8000000000000.0, 9000000000000.0, 10000000000000.0, 12000000000000.0, 15000000000000.0, 18000000000000.0, 20000000000000.0, 25000000000000.0, 30000000000000.0, 40000000000000.0, 50000000000000.0, 60000000000000.0, 70000000000000.0, 80000000000000.0, 90000000000000.0, 100000000000000.0, 120000000000000.0, 150000000000000.0, 180000000000000.0, 200000000000000.0, 250000000000000.0, 300000000000000.0, 400000000000000.0, 500000000000000.0, 600000000000000.0, 700000000000000.0, 800000000000000.0, 900000000000000.0, 1000000000000000.0, 1200000000000000.0, 1500000000000000.0, 1800000000000000.0, 2000000000000000.0, 2500000000000000.0, 3000000000000000.0, 4000000000000000.0, 5000000000000000.0, 6000000000000000.0, 7000000000000000.0, 8000000000000000.0, 9000000000000000.0, 10000000000000000.0, 12000000000000000.0, 15000000000000000.0, 18000000000000000.0, 20000000000000000.0, 25000000000000000.0, 30000000000000000.0, 40000000000000000.0, 50000000000000000.0, 60000000000000000.0, 70000000000000000.0, 80000000000000000.0, 90000000000000000.0, 100000000000000000.0, 120000000000000000.0, 150000000000000000.0, 180000000000000000.0, 200000000000000000.0, 250000000000000000.0, 300000000000000000.0, 400000000000000000.0, 500000000000000000.0, 600000000000000000.0, 700000000000000000.0, 800000000000000000.0, 900000000000000000.0, 1000000000000000000.0, 1200000000000000000.0, 1500000000000000000.0, 1800000000000000000.0, 2000000000000000000.0, 2500000000000000000.0, 3000000000000000000.0, 4000000000000000000.0, 5000000000000000000.0, 6000000000000000000.0, 7000000000000000000.0, 8000000000000000000.0, 9000000000000000000.0, 10000000000000000000.0, 12000000000000000000.0, 15000000000000000000.0, 18000000000000000000.0, 20000000000000000000.0, 25000000000000000000.0, 30000000000000000000.0, 40000000000000000000.0, 50000000000000000000.0, 60000000000000000000.0, 70000000000000000000.0, 80000000000000000000.0, 90000000000000000000.0, 100000000000000000000.0, 120000000000000000000.0, 150000000000000000000.0, 180000000000000000000.0, 200000000000000000000.0, 250000000000000000000.0, 300000000000000000000.0, 400000000000000000000.0, 500000000000000000000.0, 600000000000000000000.0, 700000000000000000000.0, 800000000000000000000.0, 900000000000000000000.0, 1000000000000000000000.0, 1200000000000000000000.0, 1500000000000000000000.0, 1800000000000000000000.0, 2000000000000000000000.0, 2500000000000000000000.0, 3000000000000000000000.0, 4000000000000000000000.0, 5000000000000000000000.0, 6000000000000000000000.0, 7000000000000000000000.0, 8000000000000000000000.0, 9000000000000000000000.0, 10000000000000000000000.0, 12000000000000000000000.0, 15000000000000000000000.0, 18000000000000000000000.0, 20000000000000000000000.0, 25000000000000000000000.0, 30000000000000000000000.0, 40000000000000000000000.0, 50000000000000000000000.0, 60000000000000000000000.0, 70000000000000000000000.0, 80000000000000000000000.0, 90000000000000000000000.0, 100000000000000000000000.0, 120000000000000000000000.0, 150000000000000000000000.0, 180000000000000000000000.0, 200000000000000000000000.0, 250000000000000000000000.0, 300000000000000000000000.0, 400000000000000000000000.0, 500000000000000000000000.0, 600000000000000000000000.0, 700000000000000000000000.0, 800000000000000000000000.0, 900000000000000000000000.0, 1000000000000000000000000.0, 1200000000000000000000000.0, 1500000000000000000000000.0, 1800000000000000000000000.0, 2000000000000000000000000.0, 2500000000000000000000000.0, 3000000000000000000000000.0, 4000000000000000000000000.0, 5000000000000000000000000.0, 6000000000000000000000000.0, 7000000000000000000000000.0, 8000000000000000000000000.0, 9000000000000000000000000.0, 10000000000000000000000000.0, 12000000000000000000000000.0, 15000000000000000000000000.0, 18000000000000000000000000.0, 20000000000000000000000000.0, 25000000000000000000000000.0, 30000000000000000000000000.0, 40000000000000000000000000.0, 50000000000000000000000000.0, 60000000000000000000000000.0, 70000000000000000000000000.0, 80000000000000000000000000.0, 90000000000000000000000000.0, 100000000000000000000000000.0, 120000000000000000000000000.0, 150000000000000000000000000.0, 180000000000000000000000000.0, 200000000000000000000000000.0, 250000000000000000000000000.0, 300000000000000000000000000.0, 400000000000000000000000000.0, 500000000000000000000000000.0, 600000000000000000000000000.0, 700000000000000000000000000.0, 800000000000000000000000000.0, 900000000000000000000000000.0, 1000000000000000000000000000.0, 1200000000000000000000000000.0, 1500000000000000000000000000.0, 1800000000000000000000000000.0, 2000000000000000000000000000.0, 2500000000000000000000000000.0, 3000000000000000000000000000.0, 4000000000000000000000000000.0, 5000000000000000000000000000.0, 6000000000000000000000000000.0, 7000000000000000000000000000.0, 8000000000000000000000000000.0, 9000000000000000000000000000.0, 10000000000000000000000000000.0, 12000000000000000000000000000.0, 15000000000000000000000000000.0, 18000000000000000000000000000.0, 20000000000000000000000000000.0, 25000000000000000000000000000.0, 30000000000000000000000000000.0, 40000000000000000000000000000.0, 50000000000000000000000000000.0, 60000000000000000000000000000.0, 70000000000000000000000000000.0, 80000000000000000000000000000.0, 90000000000000000000000000000.0, 100000000000000000000000000000.0, 120000000000000000000000000000.0, 150000000000000000000000000000.0, 180000000000000000000000000000.0, 200000000000000000000000000000.0, 250000000000000000000000000000.0, 300000000000000000000000000000.0, 400000000000000000000000000000.0, 500000000000000000000000000000.0, 600000000000000000000000000000.0, 700000000000000000000000000000.0, 800000000000000000000000000000.0, 900000000000000000000000000000.0, 1000000000000000000000000000000.0, 1200000000000000000000000000000.0, 1500000000000000000000000000000.0, 1800000000000000000000000000000.0, 2000000000000000000000000000000.0, 2500000000000000000000000000000.0, 3000000000000000000000000000000.0, 4000000000000000000000000000000.0, 5000000000000000000000000000000.0, 6000000000000000000000000000000.0, 7000000000000000000000000000000.0, 8000000000000000000000000000000.0, 9000000000000000000000000000000.0, 10000000000000000000000000000000.0, 12000000000000000000000000000000.0, 15000000000000000000000000000000.0, 18000000000000000000000000000000.0, 20000000000000000000000000000000.0, 25000000000000000000000000000000.0, 30000000000000000000000000000000.0, 40000000000000000000000000000000.0, 50000000000000000000000000000000.0, 60000000000000000000000000000000.0, 70000000000000000000000000000000.0, 80000000000000000000000000000000.0, 90000000000000000000000000000000.0, 100000000000000000000000000000000.0, 120000000000000000000000000000000.0, 150000000000000000000000000000000.0, 180000000000000000000000000000000.0, 200000000000000000000000000000000.0, 250000000000000000000000000000000.0, 300000000000000000000000000000000.0, 4000000000000000

Table 2.6-16 Water chemistry of Swift Creek in 1965.*

Station	Date** (1965)	Diss. O ₂ mg/l	pH	Turb. JTU	Color Pt units	F ⁻	SO ₄ ⁻² mg/l	Cl ⁻	Alk- alinity mg/l	Hard- ness CaCO ₃	Total PO ₄ mgP/l	NH ₄ ⁺ mg/l	NO ₃ ⁻ mg/l
Swift Creek above Allman Bay Canal	7/13	4.2	4.8	--	--	0.58	43	--	16	17	1.63	0.03	--
	7/20	2.4	4.1	--	--	0.36	6	13	--	--	1.06	0.38	0.13
	8/31 8/10	6.3 6.8	4.6 4.1	<7 <7	>460 >460	0.30 0.00	-- --	14 13	-- --	19 19	0.49 0.41	-- 1.50	0.01 0.06
Swift Creek at Highway 41	5/10	3.6	--	70	320	0.38	6	8	2	39	1.01	0.07	1.38
	6/9	--	--	--	--	0.63	--	--	--	--	1.88	--	--
	6/15	5.9	6.0	--	160	--	22	10	--	17	1.88	0.10	0.47
	6/29	4.3	5.0	300	--	0.54	23	11	1	14	1.50	2.50	0.07
	7/13	2.5	4.8	--	--	0.27	10	--	18	19	0.64	3.50	0.00
	7/20	2.7	4.6	--	--	0.79	4	10	0	--	1.16	0.31	0.10
	8/31	4.1	6.3	85	--	0.63	--	11	17	40	1.60	--	0.12
	10/26	6.2	6.7	25	320	0.90	--	20	44	159	4.09	1.60	--
Swift Creek at Entrance to Suwannee River	6/9	7.2	6.7	24	--	0.63	6	6	17	27	2.94	0.15	0.57
	7/13	5.0	5.1	70	460	0.17	12	--	0	17	0.83	0.25	--
	7/20	4.9	5.0	--	--	0.34	10	9	0	--	0.93	0.37	0.13
	8/31	--	--	--	--	0.20	--	12	32	76	1.55	--	0.00

* Data from Florida State Board of Health (1966)

** Sampling Dates up to 7/20 Represent Pre-Mining Period, Mining Activity Began Approximately 8/25.

Table 2.6-17 Means and ranges of the chemical composition of the Suwannee River Plant nonprocess water

Parameter	Minimum	Mean	Maximum
pH	4.5	6.0	7.9
Color	4.0	11.2	35.0
Ammonia-nitrogen	13.0	25.4	37.8
Nitrate-nitrogen	0.6	0.9	1.2
Organic-nitrogen	0.4	0.45	0.6
Total Phosphate as P	2.5	11.0	17.0
Alakalinity	30.0	63.0	136.0
Calcium	22.0	58.0	77.0
Magnesium	15.0	19.0	29.0
Hardness as CaCO ₃	126.0	251.0	413.0
Iron	0.13	0.27	0.49
Sulfate	183.0	250.0	530.0
Chloride	12.0	20.0	32.0
Fluoride	4.5	7.2	22.0
Conductivity	493.0		965.0

Table 2.6-18 Effluent Quality Produced by Two-stage Limestone-Lime Treatment

Analysis ⁽¹⁾	Process Water	Stage II Supernatant
pH, Std. Units	1.70	9.0
Acidity, as CaCO ₃	32,800	-
Fluoride, as F	6,600	12-20
Total P	4,000	1-13
Total Suspended Solids	69	15
Chlorides, as Cl	72	75
Sulfates, as SO ₄	6,200	2,709
Sodium as Na	896	900
Calcium, as Ca	77	375
Magnesium, as Mg	44	22
Aluminum, as Al	389	<0.2
Chrome, as Cr	0.43	<0.10
Zinc	1.46	<0.10
Iron, as Fe	263	0.10
Manganese, as Mn	7.9	0.03
Boron, as B	0.90	<0.50
Lead, as Pb	<0.10	<0.10

(1) All values in mg/l unless otherwise noted.

Table 2.6-19 Comparison of Swift Creek, Altman Bay Canal, White Springs groundwater and Occidental deep wells for selected chemical parameters (Note: All values in mg/l unless otherwise noted.)

Parameter	Stream		Groundwater from White Springs	Typical	
	Swift Creek	Altman Bay Canal ⁵		OXY Deep Wells ⁴ (min)	(max)
Specific conductivity (µmhos/cm)	456.25 ¹	719.00 ¹	275.00	329.0	528.0
Organic nitrogen	0.94 ¹	1.78 ¹	0.22	---	---
Ammonia nitrogen	5.60 ¹	23.00 ¹	0.18	---	---
Nitrate nitrogen	1.73 ¹	1.27 ¹	< 0.01	0.15	0.36
Ortho phosphate as P	32.97 ¹	52.90 ¹	0.12	0.05	0.36
Total phosphate as P	18.50 ¹	68.00 ¹	0.14	---	---
Total organic carbon	18.48 ¹	14.80 ¹	9.00	---	---
Fluoride	6.52 ¹	7.24 ¹	0.30	0.38	1.60
Sodium	29.40 ¹	31.00 ¹	5.40	6.00	18.00
Potassium	1.61 ¹	2.10 ¹	0.70	0.93	2.10
Sulfate	151.80 ¹	249.00 ¹	14.00	24.00	145.00
Total hardness	166.63 ¹	261.30 ¹	150.00	120.00	312.00
Chloride	19.48 ¹	16.33 ¹	8.20	4.50	21.00
Iron	0.56 ²	0.20 ²	0.20	0.19	0.94
Mercury	(4,3)	0.0002	(3)	---	---
Manganese	0.073 ²	21.22 ²	0.02	< 0.05	< 0.05
Cadmium	(2,3)	---	(3)	---	---
Cobalt	0.001 ²	0.008	(3)	---	---
Copper	(2,3)	0.003	(3)	< 0.01	< 0.01
Lead	0.006 ²	0.024 ²	(3)	---	---
Zinc	0.015 ²	0.006 ²	0.01	0.00	0.12
Chromium	(2,3)	0.004	(3)	---	---

¹ Mean of USGS data from STORET (1967-1977)

² Mean of data from USGS bi-monthly sampling program, 47th Report (Coffin, 1977)

³ None detectable

⁴ All well data provided by Occidental Chemical Company

⁵ Current samplings program for EIS

Table 2.6-20 Annual means, Minimums and Maximums for Selected Chemical Parameters from the USGS Sampling Station in Swift Creek (Station 02315520).*

Year (Range)	Spec. Cond. (μmhos/cm)	pH	Alk. as CaCO ₃ (mg/l)	Total P (mg/l)	Ortho-P (mg/l)	Diss.-F (mg/l)	SO ₄ (mg/l)	TOC (mg/l)	ORG-N (mg/l)	NH ₃ -N (mg/l)	NO ₃ -N (mg/l)	NO ₂ -N (mg/l)
1964 Range	318.0 430.0	6.30 6.25	10.00 17.50	---	---	3.70	100.00	---	---	---	---	---
1965 Range	430.0-510.0	6.1-6.4	9.0-26.0	---	23.00	6.35	170.00	---	---	---	---	---
1965 Range	147.0	6.47	46.00	---	10.87	5.18	124.50	---	---	---	---	---
1973 Range	200-540.0	5.72-7.10	23.0-69.0	---	4.6-15.0	2.4-9.5	109.0-140.0	---	---	---	---	---
1973 Range	424.8	5.87	6.50	---	57.17	11.95	131.50	18.00	0.72	---	---	---
1974 Range	210.0-518.0	3.7-6.6	1.0-12.0	---	11.0-130.0	2.5-29.0	136.0-132.0	14.0-22.0	0.05-1.20	---	---	---
1974 Range	509.3	6.47	7.00	19.50	53.83	7.30	105.00	14.00	0.51	5.10	0.07	3.64
1977 Range	250.0-664.0	5.2-7.0	7.0-7.0	8.5-26.0	25.0-74.0	4.1-10.0	170.200	11.0-17.0	0.0-1.4	1.8-8.4	0.04-1.70	1.1-5.7
1978 Range	433.5	5.62	5.00	12.33	20.00	0.13	160.00	15.20	0.73	2.83	2.46	3.75
1978 Range	217.0-660.0	3.7-6.5	3.0-7.0	1.5-21.0	20.0-20.0	3.1-18.0	130.0-190.0	0.00-40.0	0.0-2.2	1.1-4.8	0.06-5.00	0.9-6.0
1978 Range	345.2	5.84	10.00	11.38	---	4.62	124.00	16.08	0.63	3.55	1.19	3.88
1978 Range	195.0-680.0	4.1-6.6	9.0-11.0	7.2-16.0	---	3.7-6.0	76.0-172.0	2.0-36.0	0.07-1.6	0.57-5.4	0.30-2.00	0.4-7.7
1978 Range	563.4	5.73	2.00	26.50	---	7.88	285.00	19.83	1.00	8.18	2.35	3.42
1978 Range	383.0-607.0	4.8-6.6	2.0-2.0	11.0-42.0	---	4.3-12.0	280.0-290.0	10.0-44.0	0.42-2.00	1.6-23.0	1.1-3.7	1.2-5.5
1978 Range	555.5	5.95	7.67	20.50	---	6.37	170.0	17.50	1.00	6.18	2.20	6.47
1978 Range	400.0-870.0	4.6-6.7	1.0-17.0	9.2-36.0	---	2.3-11.0	130-240	10.0-23.0	0.06-1.1	2.6-11.0	1.2-4.1	4.8-9.0
1976 Range	465.0	6.40	11.10	21.55	---	5.20	159.00	23.42	1.92	6.25	1.71	6.36
1976 Range	295.0-670.0	5.9-6.8	0.00-34.0	8.6-30.0	---	2.0-9.5	120.0-230.0	13.0-39.0	0.17-7.90	3.2-10.0	0.01-2.60	4.5-8.6
1977 Range	497.6	6.49	5.50	17.71	---	5.00	110.75	23.83	0.99	7.07	1.37	4.63
1977 Range	250.0-670.0	6.2-8.7	0.00-13.0	11.0-23.0	---	3.4-7.7	69.0-180.0	18.0-30.0	0.30-2.60	3.9-13.00	0.92-3.2	1.1-10.0
AVERAGE	456.2	6.39	12.3	10.49	32.97	6.523	151.79	18.48	0.937	5.59	1.73	4.31

* Data from SLUGT

Table 2.6-21 One-way analysis of variance comparing annual means for selected chemical parameters as measured by U.S.G.S.

Parameter Period of Record	Analysis of Variance				
Specific Conductivity 1968-1977	ANOVA				
	Source	SS	df	MS	F
	Treatments	279429.10	9	31047.68	1.33
	Error	1194840.34	51	23428.24	
	Total	1474269.44	60		P < 0.26
Organic-N as N 1970-1977	ANOVA				
	Source	SS	df	MS	F
	Treatments	13.09	7	1.87	1.47
	Error	57.18	45	1.27	
	Total	70.27	52		P < 0.21
NH ₃ -N - Total 1971-1977	ANOVA				
	Source	SS	df	MS	F
	Treatments	132.93	6	22.16	1.64
	Error	513.29	38	13.51	
	Total	646.22	44		P < 0.16
NO ₃ -N 1971-1977	ANOVA				
	Source	SS	df	MS	F
	Treatments	10.79	6	1.80	1.32
	Error	50.30	37	1.36	
	Total	61.08	43		P < 0.27
TOC 1970-1977	ANOVA				
	Source	SS	df	MS	F
	Treatments	611.03	7	87.29	0.96
	Error	3636.09	40	90.90	
	Total	4247.12	47		P < 0.47
Fluoride - Diss. 1968-1977	ANOVA				
	Source	SS	df	MS	F
	Treatment	275.24	9	30.58	2.04
	Error	780.56	52	15.01	
	Total	1055.80	61		P < 0.53
Ortho-P as PO ₄ 1968-1971	ANOVA				
	Source	SS	df	MS	F
	Treatment	5795.11	3	1931.70	2.03
	Error	12350.57	13	950.04	
	Total	19145.68	16		P < 0.19
Total Phosphate as P 1971-1977	ANOVA				
	Source	SS	df	MS	F
	Treatment	1055.40	6	175.9	2.63
	Error	2745.04	41	66.95	
	Total	3800.44	47		P < 0.03
Sulfate 1968-1977	ANOVA				
	Source	SS	df	MS	F
	Treatment	51654.12	9	5739.35	3.27
	Error	36805.75	21	1752.65	
	Total	88459.87	30		P < 0.02

Table 2.6-22 Concentrations of total ammonia ($\text{NH}_3 + \text{NH}_4^+$) which contain an un-ionized ammonia concentration of 0.020 mg/l NH_3^* .

Temperature (°C)	pH Value								
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
5	160.0	51	16.0	5.1	1.6	0.53	0.18	0.071	0.036
10	110.0	34	11.0	3.4	1.1	0.36	0.13	0.054	0.031
15	73.0	23	7.3	2.3	0.75	0.25	0.093	0.043	0.027
20	50.0	16	5.1	1.6	0.52	0.18	0.070	0.036	0.025
25	35.0	11	3.5	1.1	0.37	0.13	0.055	0.031	0.024
30	25.0	7.9	2.5	0.81	0.27	0.099	0.045	0.028	0.022

Table 2.6-23 Conditions in Swift Creek necessary to determine NH_3 levels.

Date	Ammonia	pH	Temperature ¹
12-7-71	8.4	6.8	15 ²
2-7-73	5.4	6.3	15
6-5-73	5.3	5.8	24
2-12-74	23.0	6.4	15
4-3-74	7.2	5.5	20
6-11-74	9.0	4.8	26
10-8-74	6.2	5.7	25
9-29-75	10.0	6.7	25
12-8-75	11.0	6.3	14
2-2-76	6.5	6.3	14
4-5-76	7.4	6.7	21
5-3-76	6.0	6.5	23
5-21-76	9.1	6.6	23
8-30-76	5.0	6.7	26
10-4-76	8.4	6.4	22
11-1-76	10.0	6.8	18
11-30-76	5.6	6.5	18
1-31-77	6.1	6.5	15 ²
2-28-77	5.1	6.7	15 ²
4-13-77	6.9	6.7	20 ²
6-6-77	6.3	6.5	25 ²
8-1-77	8.2	6.3	25 ²
10-3-77	13.0	6.5	23 ²

¹ Based on monthly averages.

² Estimated from previous years.

Table 2.6-24 Mass loadings under average flow of selected parameters for Swift Creek and downstream Suwannee River stations. (All values in kg/day).

Station	Total Phosphorous (P)	Total Nitrogen (N)	Total Organic Carbon (TOC)	Sulfate (SO ₄)	Fluoride (F)
Suwannee River at White Springs (USGS #02315500)	428	3,676	148,000	20,400	912
Swift Creek at mouth	2,300	1,019	2,760	21,700	766
Suwannee Springs (USGS #02315550)	2,850	4,515	139,000	50,800	1,900
Alapaha River near Statenville	261	*	39,500	4,490	398
Withlacoochee River at mouth	639	3,528	67,400	22,400	1,380
Suwannee River at Branford (USGS #02320500)	3,340	10,633	212,000	147,000	3,920
Sante Fe River at Ft. White	317	*	*	82,900	*
Suwannee River at Wilcox (USGS #02323500)	3,830	14,530	269,000	295,000	5,770

* Insufficient data to calculate mass loading

Table 2.6-25 Mass loadings under low flow (M7,10) of selected parameters for Swift Creek and downstream Suwannee River stations. (All values in kg/day).

Station	Total Phosphorous (P)	Total Nitrogen (N)	Total Organic Carbon (TOC)	Sulfate (SO ₄)	Fluoride (F)
Suwannee River at White Springs (USGS #02315500)	9.33	23	460	257	6.6
Swift Creek at mouth					
Suwannee Springs (USGS #02315550)	1,050	485	917	11,000	347
Alapaha River near Statenville	618	499	2,330	4,080	98
Withlacoochee River at mouth	25	*	363	136	15
Suwannee River at Branford (USGS #02320500)	78	244	2,590	6,570	133
Sante Fe River at Ft. White	1,110	5,450	22,100	93,100	848
Suwannee River at Wilcox (USGS #02323500)	139	*	*	62,600	327
	1,370	13,455	52,500	273,000	2,170

* Insufficient data

TABLE 2.6-27
GROUNDWATER QUALITY DATA
SHIFT CREEK SITE

Well Number	Observation Well Set 1				Observation Well Set 2				Observation Well Set 3			
	1-AA	1-B	1-C		2-A	2-B	2-C		3-B	3-C*	3-U*	3-E
Depth of Collection Zone	1-13'	20-34'	90-120'		1-7'	26-38'	105-129'		37-48'	103-120'	140-156'	243-300'
Date Sampled	4/11/78	4/11/78	4/11/78		4/11/78	4/11/78	4/11/78		4/12/78	4/12/78	4/12/78	4/12/78
Water Level Elevation	139.1	139.1	54.4		139.5	139.1	53.7		138.6	59.8	55.2	52.3
Sample Number	9252	9254	9256		9257	9259	9261		9263	9265	9267	9269
Temperature °C	19	20	22		20	21	20		--	--	--	21
Color (APHA Units)	2	1	1		5	0	1		0	0	0	0
pH (Field)	6.4	6.9	--		5.8	7.2	6.2		6.6	--	--	7.2
pH (Lab)	6.2	7.1	7.2		5.9	6.8	7.6		7.2	12.1	11.9	7.3
NUTRIENTS mg/l												
Nitrogen-N												
Ammonium	0.15	<0.02	0.17		0.10	<0.02	0.13		<0.02	0.47	0.90	--
Nitrate	0.010	0.007	0.009		0.010	<0.005	<0.005		0.013	0.097	0.020	<0.05
Organic Dissolved	0.06	0.02	0.04		0.21	0.03	0.12		<0.02	0.18	0.16	0.10
Phosphates-P												
Ortho	1.00	0.50	3.20		0.400	0.506	0.340		1.43	0.086	0.093	0.160
Total Phosphorus	2.11	0.68	5.65		0.500	0.51	0.36		1.73	0.11	0.11	0.17
Dissolved Organic Carbon	6.0	7.5	9.0		8.0	6.5	8.5		6.0	5.5	10.5	25.0
MAJOR CONSTITUENTS, mg/l												
Iron	3.1	0.58	4.6		0.79	1.0	0.37		1.4	0.22	0.34	0.28
Calcium	8.0	26.6	29.6		3.0	20.1	25.0		22.4	2.47	335	63.0
Magnesium	2.1	22.9	21.2		1.3	11.1	19.7		21.6	1.2	<0.10	25.4
Sodium	3.7	4.4	15.0		4.6	6.0	24.8		8.5	423	48.3	9.9
Potassium	0.24	0.48	7.17		0.84	0.84	3.32		0.84	170	63.7	6.6
Sulfate	5.0	2.4	<1.0		7.2	2.2	6.0		1.8	<1.0	6.2	13
Sulfides	<0.02	0.09	0.31		<0.01	0.17	0.18		0.18	0.12	0.27	1.23
Chloride	5.0	7.1	4.5		3.0	5.0	4.5		7.1	3.5	3.5	6.6
Fluoride	0.66	0.64	0.92		0.18	0.35	0.88		0.28	0.79	0.74	0.42
Strontium	<0.05	<0.05	0.09		<0.05	<0.05	0.09		<0.05	10.2	3.2	0.09
Dissolved Solids	59	181	424		53	149	227		263	1620	880	322
Total Solids	89	200	1280		80	158	262		326	1710	904	334
Hardness (Total)	29	161	161		13	96	146		145	622	838	262
Alkalinity (CaCO ₃)	33	191	253		11	125	208		208	1520	878	268
Conductivity (µmhos/cm @ 25°C)	83	339	440		53	236	369		370	5820	3670	480
TRACE METALS, mg/l												
Arsenic	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	0.04
Chromium	<0.002	0.003	0.074		0.004	<0.002	0.006		0.010	0.011	0.007	0.004
Manganese	0.012	0.020	0.064		0.044	0.030	0.022		0.053	0.014	0.008	0.056
Mercury	<0.0002	<0.0002	<0.0002		0.0005	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002
Zinc	0.032	0.005	0.104		0.015	0.017	0.041		0.020	0.046	0.250	0.094
RADIO-CHEMICAL DATA, pCi/l												
Gross Alpha Radiation	4.4	4.5	13.4		--	<3.0	<3.4		3.0	--	10.6	23.9

*Values reflect contamination from cement groutings (e.g., pH, conductivity, calcium, total hardness....)

All Sample Sets are "Z."

Locations shown in Figures 2.6-9 and 2.6-22.

TABLE 2.6-27
(continued)GROUNDWATER QUALITY DATA
SWIFT CREEK SITE

Well Number	Observation Well Set 4				OXY Shallow Potable Wells		OXY Deep Production Wells		Return Water Ditch	
	4-A	4-B	4-C	4-D	SCD-1	SCD-2	SC-1	SC-2	RD-1	
Depth of Collection Zone	1-10'	31-43'	62-73'		168-270'	63-75'	180-800'	186-800'		
Date Sampled	2/23/78	4/12/78	4/12/78		4/13/78	4/19/78	4/19/78	4/12/78	4/19/78	
Water Level Elevation	140.8	138.7	137.6		--	--	--	--	--	
Sample Number	9061	9271	9273		9277	9378	9377	9278	9379	
Temperature °C	14	21	21		21	19.5	20.5	21	22	
Color (APHA Units)	180	0	0		1	0	2	10	5	
pH (Field)	--	6.8	8.6		7.1	--	--	7.2	--	
pH (Lab)	4.9	7.0	7.4		7.8	6.8	7.1	7.9	6.9	
NUTRIENTS mg/l										
Nitrogen-N	0.57	<0.02	0.03		0.05	<0.02	0.09	0.02	0.27	
Ammonium	<0.005	<0.005	<0.005		0.010	0.007	0.038	0.013	0.030	
Nitrate	1.05	0.02	0.06		0.23	0.31	0.19	0.22	0.34	
Organic Dissolved										
Phosphates-P	0.080	0.130	0.340		0.053	0.356	0.228	0.093	0.663	
Ortho	0.404	0.27	0.41		0.15	0.46	0.32	0.13	0.92	
Total Phosphorus	62.5	4.5	6.0		3.0	71.0	10.0	5.0	41.0	
Dissolved Organic Carbon										
MAJOR CONSTITUENTS, mg/l										
Iron	1.4	0.37	0.80		0.09	2.8	1.1	0.38	0.93	
Calcium	5.1	21.3	44.2		65.3	54.7	54.7	54.7	25.5	
Magnesium	4.3	22.6	19.3		25.9	24.4	20.7	23.8	12.9	
Sodium	21.5	6.0	6.6		11.3	3.8	10.1	12.0	5.1	
Potassium	8.9	0.06	1.20		0.96	0.60	0.84	1.2	0.84	
Sulfate	40	3.1	3.6		9.8	<1.0	38	23	16	
Sulfides	0.36	0.06	0.10		0.14	0.29	<0.02	0.96	0.30	
Chloride	23	7.1	5.6		8.6	4.5	11	9.1	9.5	
Fluoride	0.16	0.31	0.42		0.33	0.42	0.39	0.38	1.20	
Strontium	<0.13	<0.05	0.06		0.07	0.06	0.06	0.08	<0.05	
Dissolved Solids	260	224	214		380	258	248	302	210	
Total Solids	549	232	294		382	268	260	310	226	
Hardness (Total)	30	14	190		270	237	222	214	117	
Alkalinity (CaCO ₃)	5.0	222	194		277	252	210	192	118	
Conductivity (µmhos/cm @ 25°C)	200	392	348		467	435	433	368	263	
TRACE METALS, mg/l										
Arsenic	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02	<0.02	
Chromium	0.006	<0.0002	0.004		<0.002	0.003	0.009	<0.002	0.007	
Manganese	0.028	0.032	0.031		0.031	0.104	0.041	0.036	0.026	
Mercury	<0.0002	<0.0002	0.0003		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Zinc	0.026	<0.004	0.008		0.022	4.3	0.048	0.010	0.007	
RADIO-CHEMICAL DATA, pCi/l										
Gross Alpha Radiation	3.0	3.5	<2.1		<3.1	<1.2	<1.4	<1.6	3.4	

All Sample Sets are "Z" (except for Well 4-A).
Locations shown in Figures 2.6-9 and 2.6-22.

TABLE 2.6-28

WATER QUALITY IN FLORIDAN AQUIFER

	Swift Creek Occidental Supply Wells and Observation Well 3-E (>200 feet deep)	Osceola National Forest (Miller et al, 1977)	Jasper Well No. 3 2/18/76-3/1/76
pH	7.1-7.9	7.2-7.8	7.0-7.3
Specific Conductance, µmhos/cm	368-538	361-508	-
Dissolved Solids, mg/l	246-421	232-329	540
Calcium, mg/l	51-72	42-62	89-92
Magnesium, mg/l	18-30	17-30	45
Sodium, mg/l	7-25	4-19	6
Potassium, mg/l	0.8-6.0	0.7-5.5	1.2-1.4
Sulfate, mg/l	10-127	0.5-20	190-210
Chloride, mg/l	3-15	5.2-18	8.4-8.6
Fluoride, mg/l	0.32-1.6	0.2-0.6	0.3
Dissolved Organic Carbon, mg/l	3-25	0-7*	-
Iron, mg/l	0.06-1.1	0.02-0.96	1.4
Manganese, mg/l	0.02-0.10	0.01-0.12	-
Zinc, mg/l	0-0.11	0-0.02	-

* Total Organic Carbon

TABLE 2.6-29

WATER USE IN 1975 IN HAMILTON COUNTY
(All Values in Millions of Gallons per Day - MGD)

<u>Water-Use</u>	<u>Groundwater</u>	<u>Surface Water</u>
Municipal:	0.60	0.00
Public Supply	0.53	0.00
Industry	0.02	0.00
Commercial	0.05	0.00
Rural:	0.69	0.07
Domestic	0.28	0.00
Livestock	0.41	0.07
Irrigation	1.34	0.15
Industrial	30.30	0.00*
Total	32.39	0.22*

*305 MGD of water wholly recycled within the hydraulic system of the phosphate industry are not included in these data.

Data from Leach (1977)

TABLE 2.6-30
WATER USE IN 1975 IN THE THREE-COUNTY AREA
(COLUMBIA, HAMILTON, AND SUWANNEE)
(All Values in Millions of Gallons per Day - MGD)

GW = Groundwater
SW = Surface Water

County	Municipal		Rural		Irrigation		Thermo-Electric and Industrial	
	GW	SW	GW	SW	GW	SW	GW	SW
Columbia	1.68	0	1.60	0.17	10.75	1.19	1.12	0
Hamilton	0.60	0	0.69	0.07	1.34	0.15	30.30	0 ¹
Suwannee	1.12	0	1.52	0.02	1.42	0	2.40	173.73 ²
TOTAL	3.40	0	3.81	0.26	13.51	1.34	33.82	173.73 ^{1,2}
	3.40		4.07		14.85		207.55 ^{1,2}	

TOTAL USE = 229.87 MGD^{1,2}

¹305 MGD of water wholly recycled within the hydraulic systems of the phosphate industry is not included in these data.

²172 MGD of water used in conjunction with thermo-electric power is returned to the Suwannee River.

Data from Leach (1977)

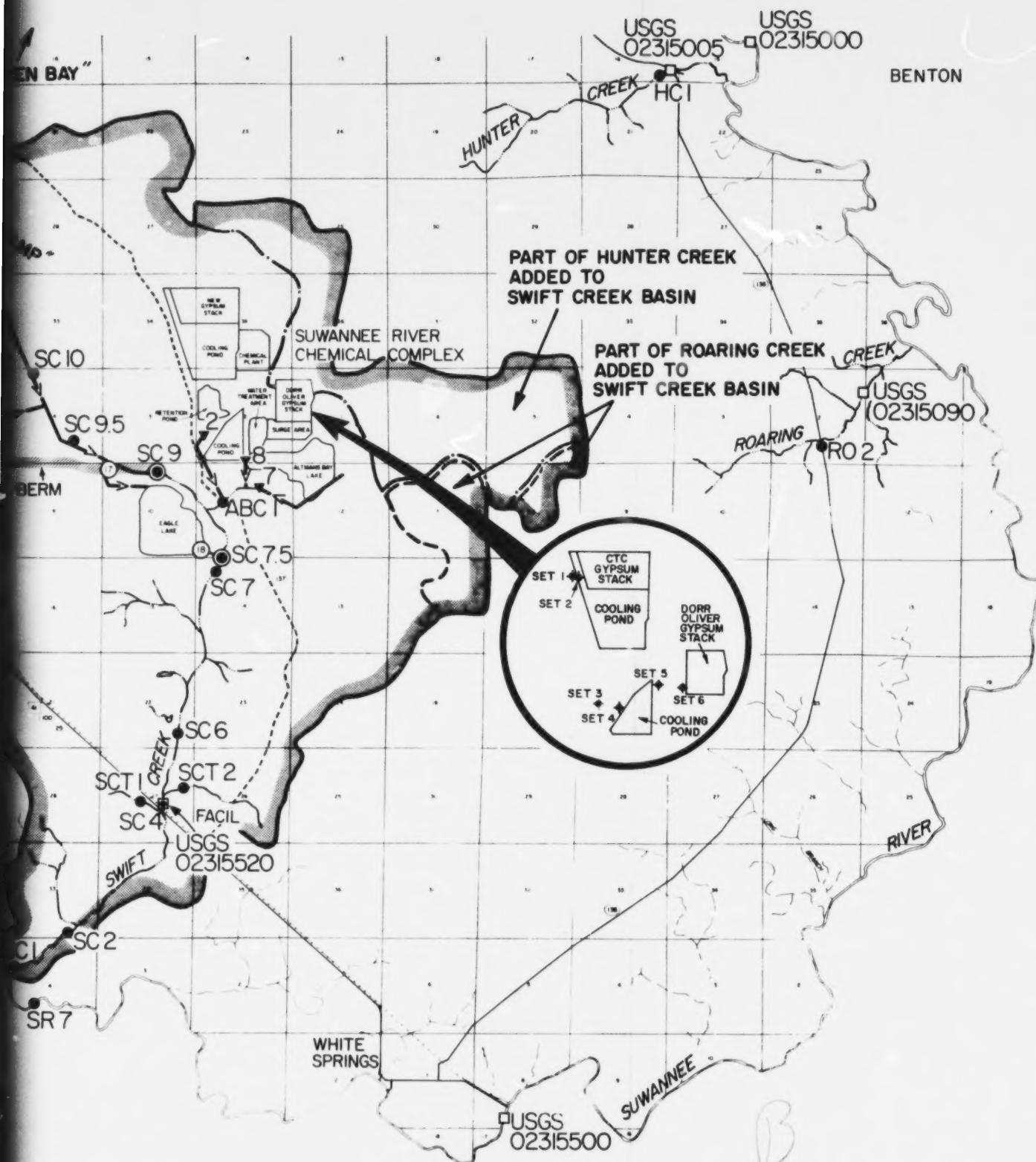
PART OF SWIFT CREEK BASIN
CUT OFF AND DRAINED TO
CAMP BRANCH

USGS
02315550
SUWANNEE
SPRINGS

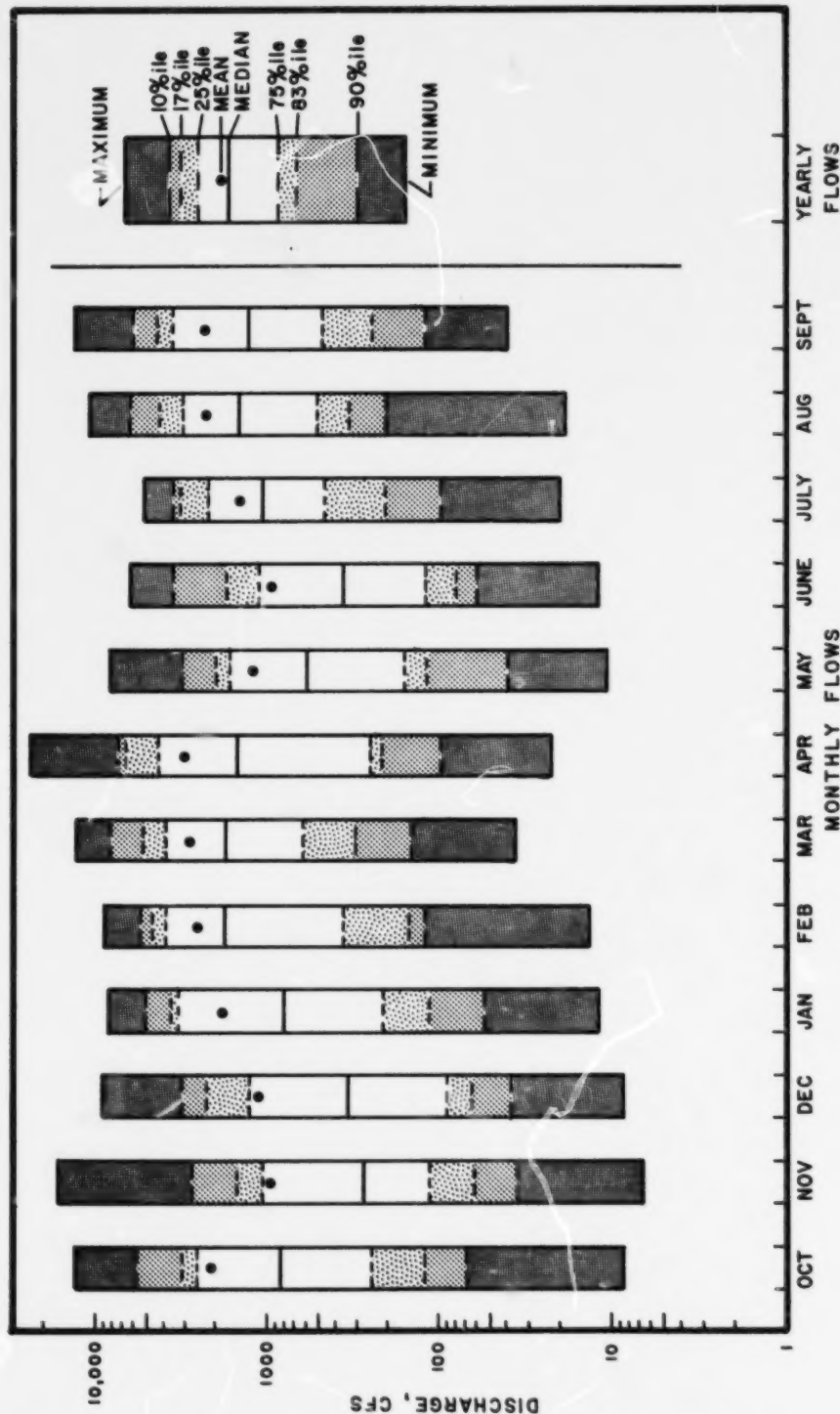
OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX
HAMILTON COUNTY, FLORIDA

LEGEND	
EXISTING SWIFT CREEK BASIN BOUNDARY	● EIS WATER QUALITY SAMPLING SITE
→ DRAINAGE DITCHES	○ EIS STREAM GAUGE LOCATION
▼ OCCIDENTAL COMPANY FLUME WITH RECORDING GAUGE	□ U.S.G.S. STATION
⊖ CONTROL WEIR (OCCIDENTAL)	◆ OBSERVATION WELL LOCATIONS (each with 3 to 5 piezometers at varying depths)

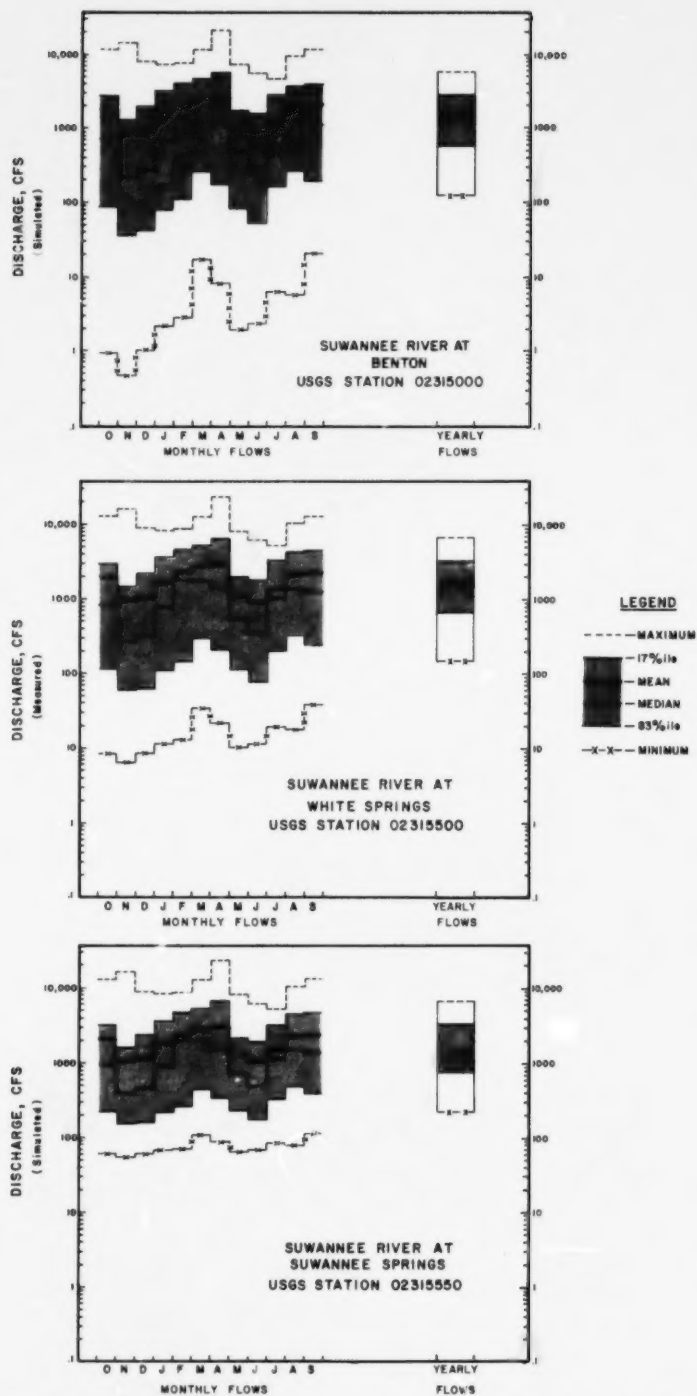
SWIFT CREEK DRAINAGE BASIN AND LOCATIO



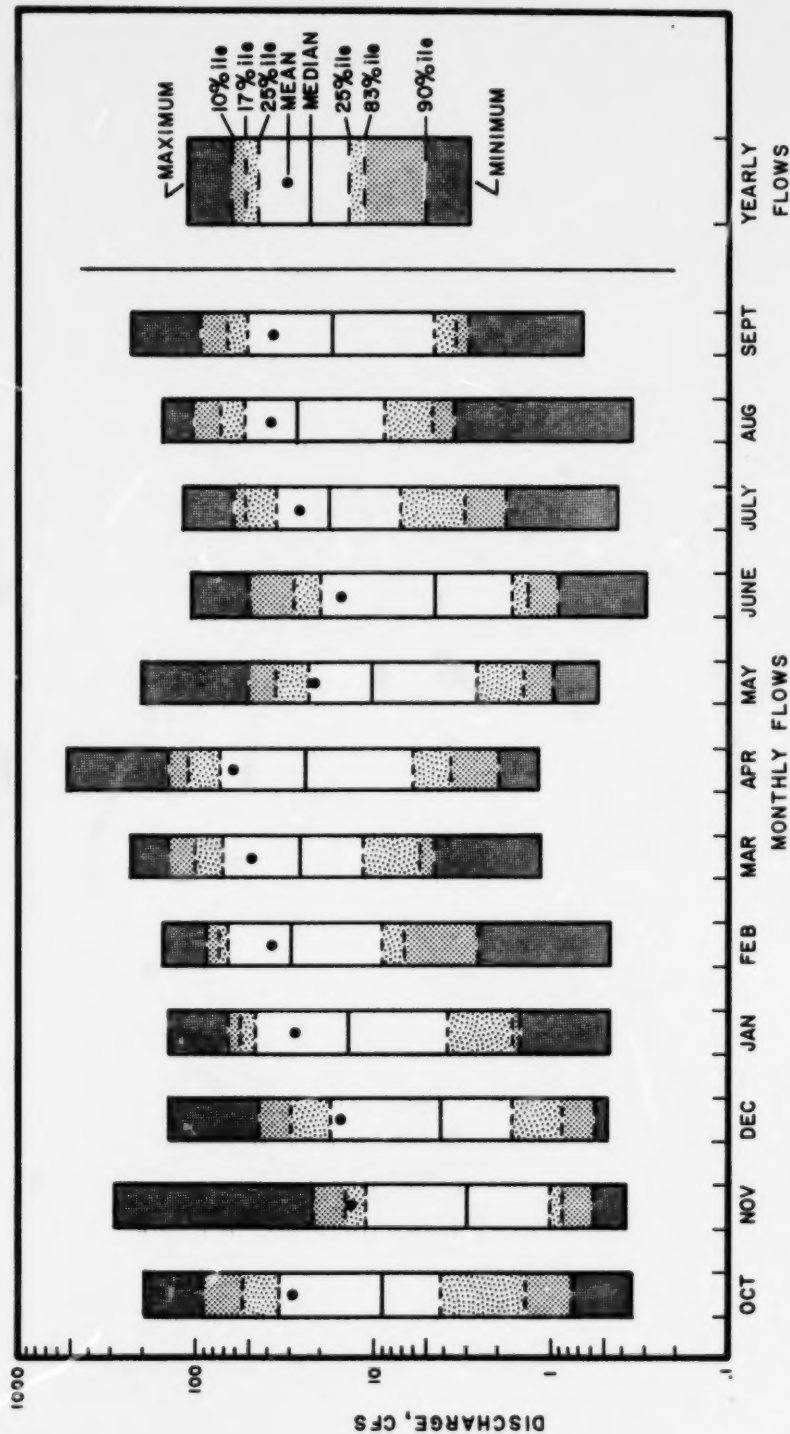
SWIFT CREEK DRAINAGE BASIN AND LOCATION OF SAMPLING STATIONS



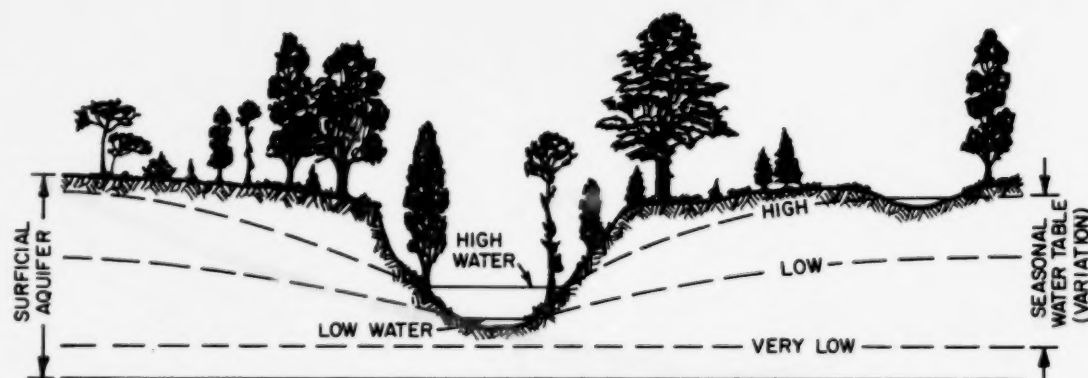
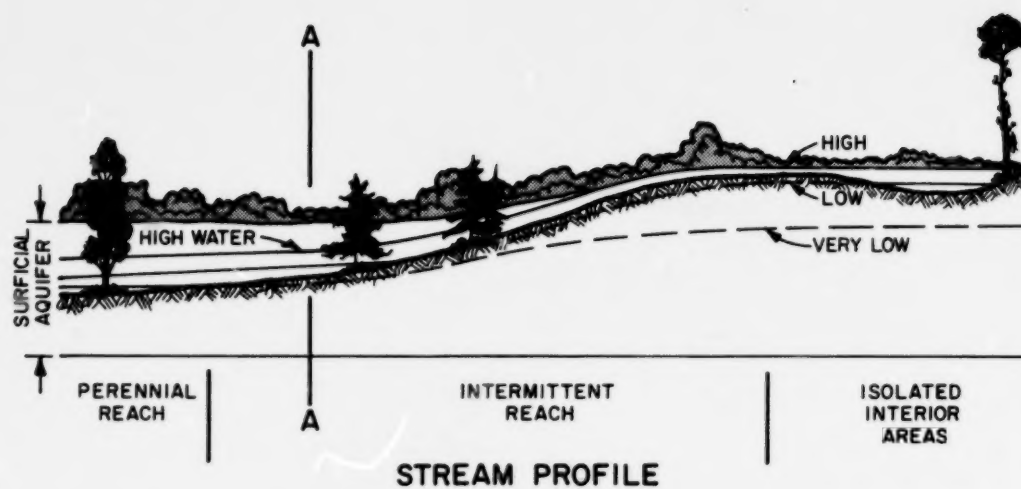
VARIABILITY OF MONTHLY AND YEARLY STREAMFLOW
STATION NO. 02315500
SUWANNEE RIVER AT WHITE SPRINGS, FLORIDA



MONTHLY AND YEARLY FLOWS OF THE SUWANNEE RIVER AT BENTON, WHITE SPRINGS, AND SUWANNEE SPRINGS, FLORIDA

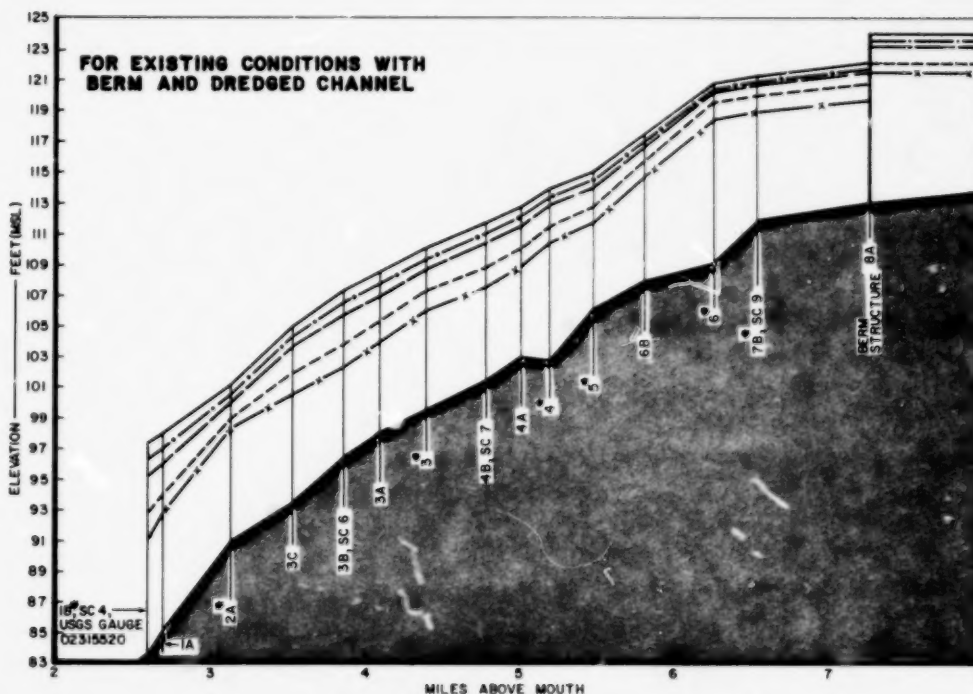
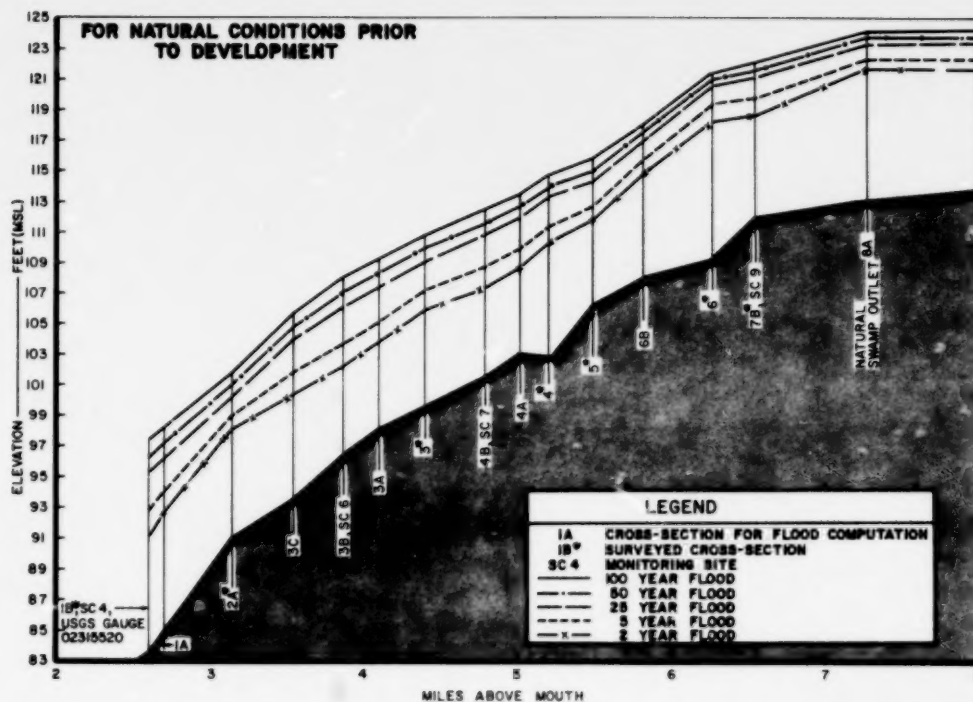


ESTIMATED VARIATION IN NATURAL MONTHLY AND YEARLY STREAMFLOW
STATION NO. 02315520
SWIFT CREEK AT FACIL, FLORIDA

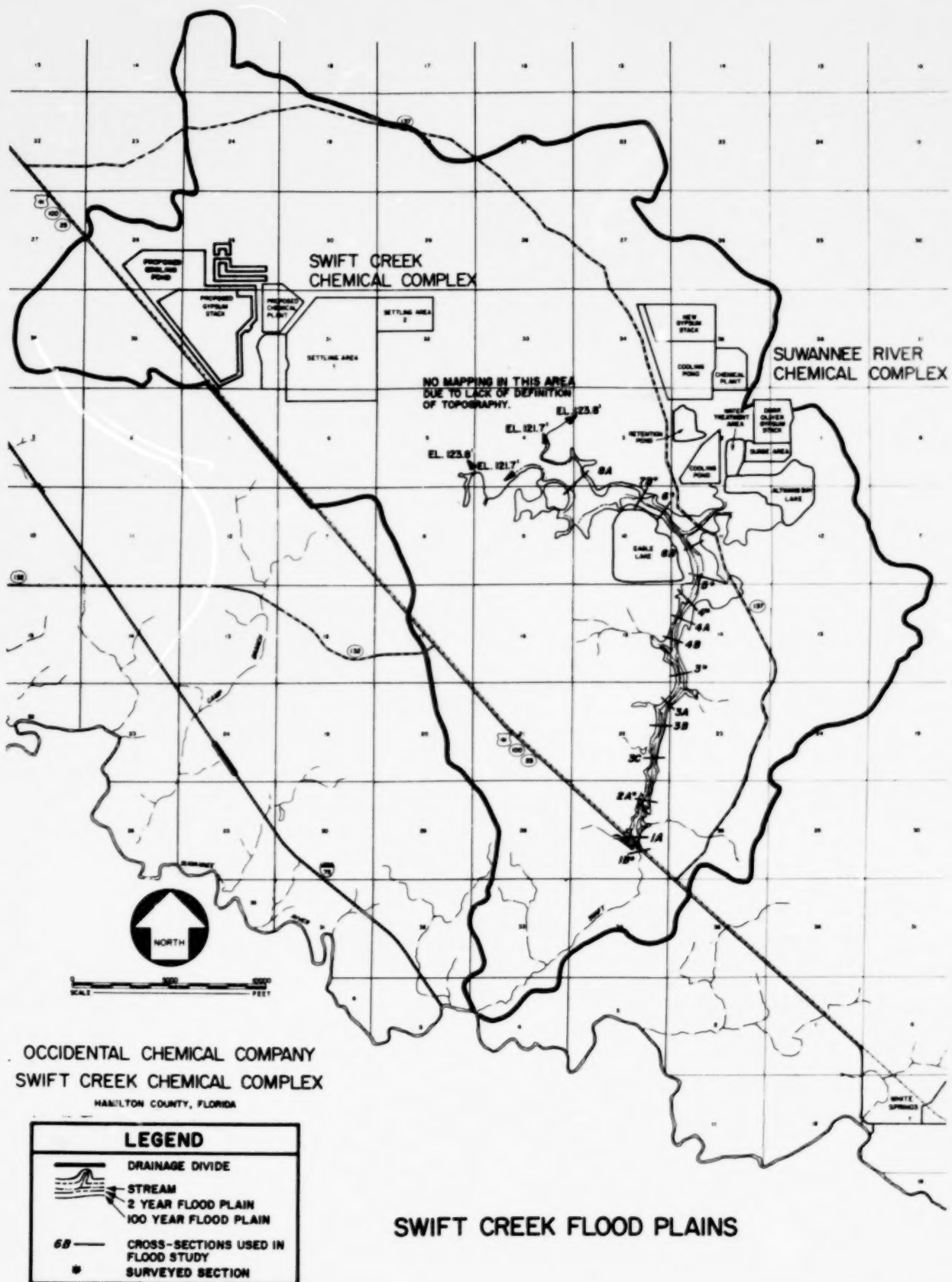


HIGH WATER TABLE = HIGH BASE FLOW
 LOW WATER TABLE = LOW BASE FLOW
 VERY LOW WATER TABLE (BELOW STREAM BED) = DRY STREAM

**PROFILE SHOWING RELATIONSHIP OF WATER TABLE LEVEL
 AND FLOW INTO STREAMS**



**SWIFT CREEK FLOOD PROFILE
WITH FLOOD ROUTING THROUGH SWIFT CREEK SWAMP**





(From USGS Flood Maps Dated-1961)

FLOOD-PRONE AREAS OF SWIFT CREEK DRAINAGE BASIN

SET 1

SET 2

SET 3

SET 4

GROUND SURFACE ELEVATION, _____

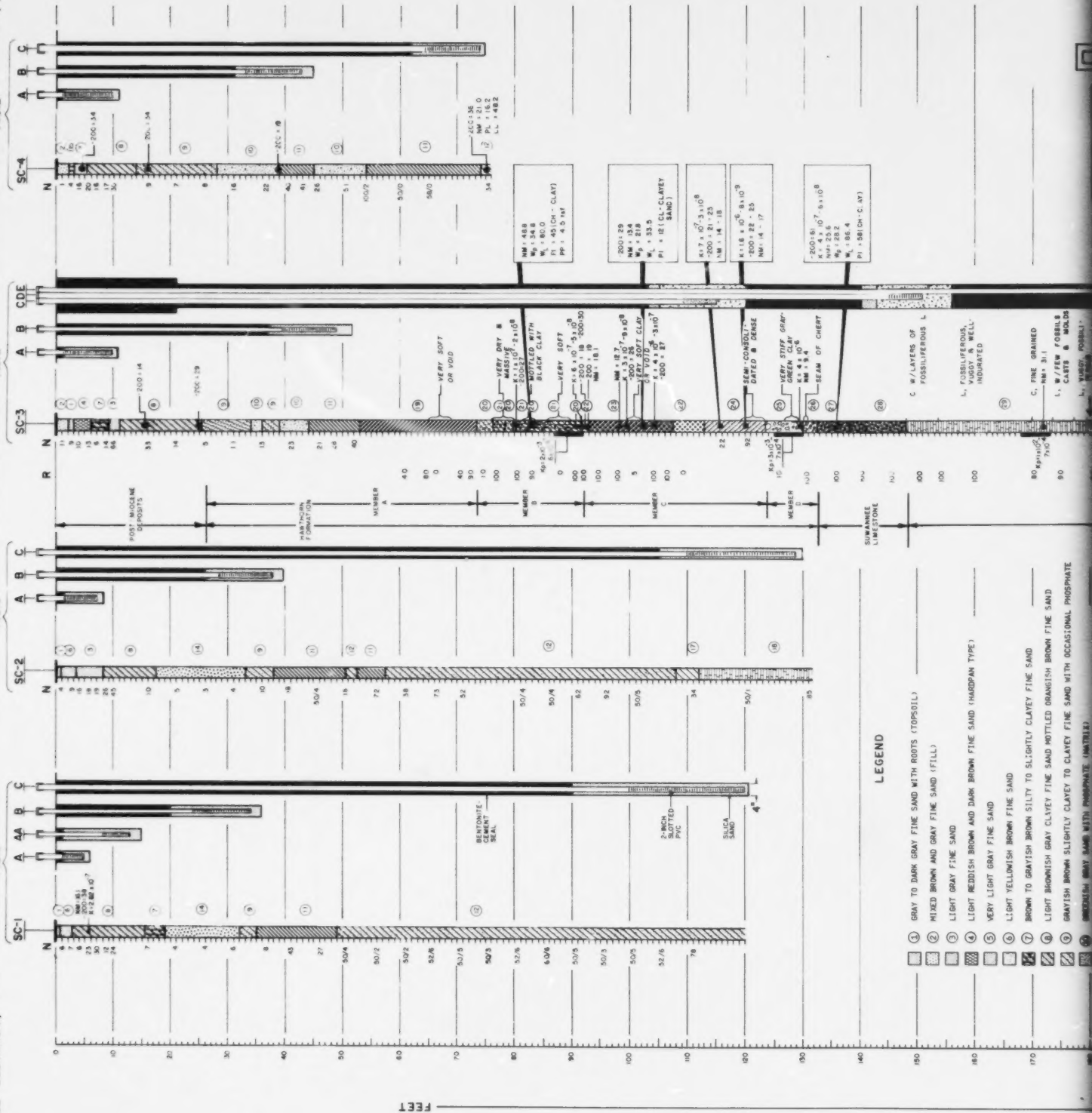
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143.0

146.2

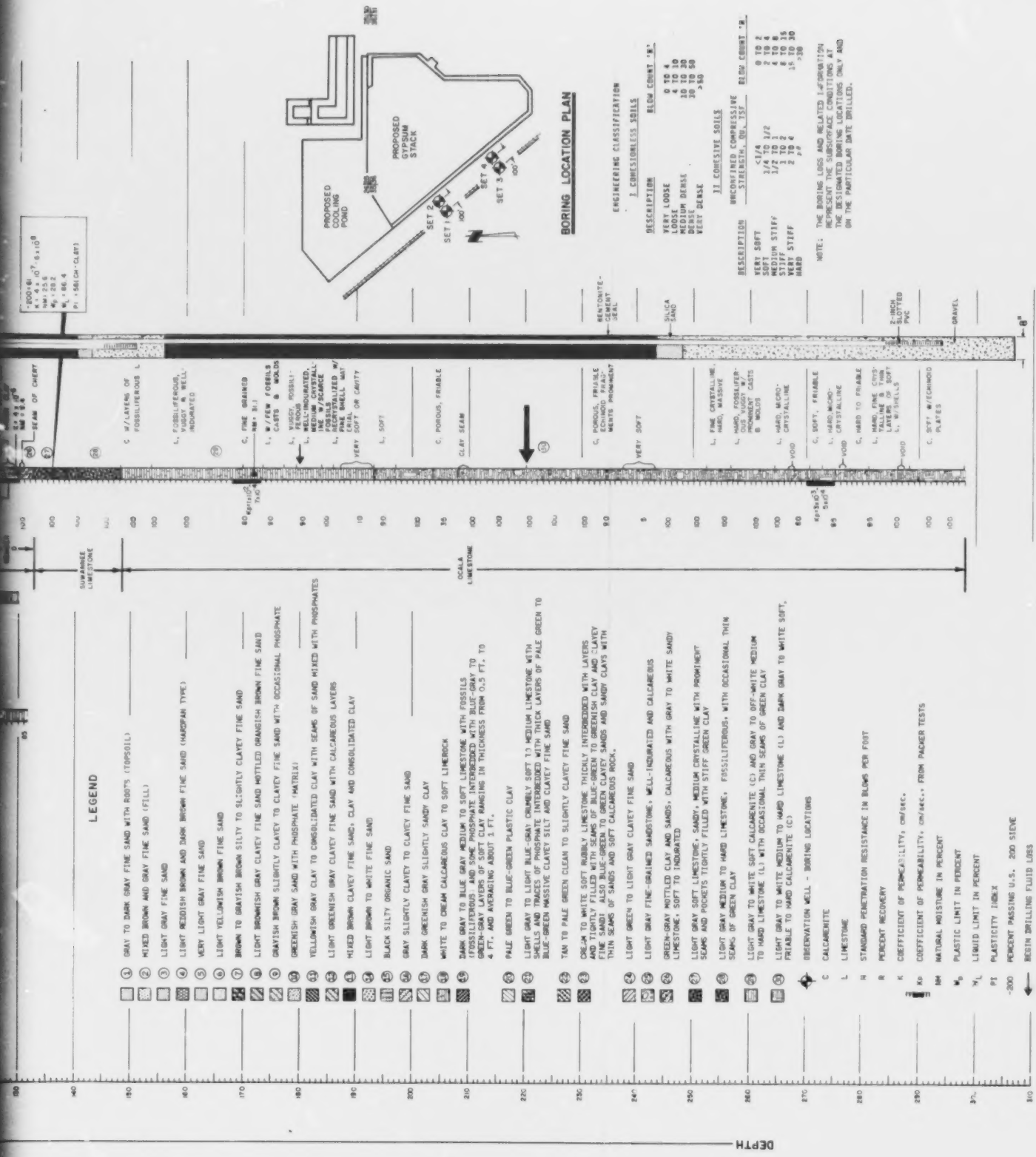
143.2

FT. (MSU)



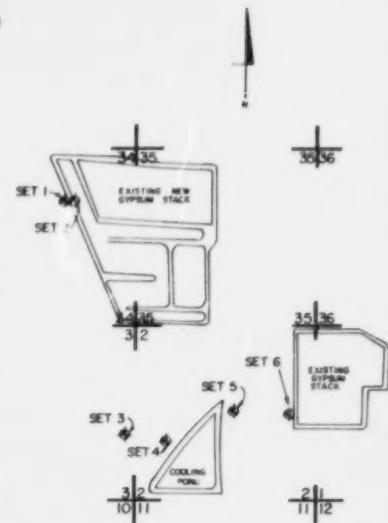
LEGEND

- ① GRAY TO DARK GRAY FINE SAND WITH ROOTS (TOPSOIL)
- ② MIXED BROWN AND GRAY FINE SAND (FILL)
- ③ LIGHT GRAY FINE SAND
- ④ LIGHT REDDISH BROWN AND DARK BROWN FINE SAND (HARDPAN TYPE)
- ⑤ VERY LIGHT GRAY FINE SAND
- ⑥ LIGHT YELLOWISH BROWN FINE SAND
- ⑦ BROWN TO GRAYISH BROWN SILTY TO SLIGHTLY CLAYEY FINE SAND
- ⑧ LIGHT BROWNISH GRAY CLAYEY FINE SAND MOTTLED ORANGE BROWN FINE SAND
- ⑨ GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND WITH OCCASIONAL PHOSPHATE
- ⑩ ORANGE BROWN GRAY SAND WITH PHOSPHATE (MATRIX)



OBSERVATION WELLS AT PROPOSED SWIFT CREEK CHEMICAL COMPLEX





BORING LOCATION PLAN

- LEGEND
- ① GRAY TO DARK GRAY FINE SAND w/ROOTS - TOPSOIL
 - ② MIXED BROWN AND GRAY FINE SAND (FILL)
 - ③ LIGHT GRAY FINE SAND
 - ④ LIGHT REDDISH BROWN AND DARK BROWN FINE SAND (HARDPAN TYPE)
 - ⑤ VERY LIGHT GRAY FINE SAND
 - ⑥ LIGHT YELLOWISH BROWN FINE SAND
 - ⑦ BROWN TO GRAYISH BROWN SILTY TO SLIGHTLY CLAYEY FINE SAND
 - ⑧ LIGHT BROWNISH GRAY CLAYEY FINE SAND MOTTLED GRAYISH BROWN FINE SAND
 - ⑨ GRAYISH BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND w/OCCASIONAL PHOSPHATE
 - ⑩ GREENISH GRAY SAND w/PHOSPHATE (MATRIX)
 - ⑪ YELLOWISH GRAY CLAY TO CONSOLIDATED CLAY w/ SEAMS OF SAND MIXED w/PHOSPHATES
 - ⑫ LIGHT GREENISH GRAY CLAYEY FINE SAND w/ CALCAREOUS LAYERS
 - ⑬ MIXED BROWN CLAYEY FINE SAND, CLAY AND CONSOLIDATED CLAY
 - ⑭ LIGHT BROWN TO WHITE FINE SAND
 - ⑮ BLACK SILTY ORGANIC SAND
 - ⑯ GRAY SLIGHTLY CLAYEY TO CLAYEY FINE SAND
 - ⑰ DARK GREENISH GRAY SLIGHTLY SANDY CLAY
 - ⑱ WHITE TO CREAM CALCAREOUS CLAY TO SOFT LIMEROCK
 - OBSERVATION WELLS-BORING LOCATIONS

N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT

-200 PERCENT PASSING NO.200 SIEVE

NM NATURAL MOISTURE IN PERCENT

PL PLASTIC LIMIT IN PERCENT

LL LIQUID LIMIT IN PERCENT

← PARTIAL LOSS OF DRILLING FLUID CIRCULATION

→ COMPLETE LOSS OF DRILLING FLUID CIRCULATION

NOTE: THE BORING LOGS AND RELATED INFORMATION REPRESENT SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ONLY AND ON THE PARTICULAR DATE DRILLED.

ENGINEERING CLASSIFICATION

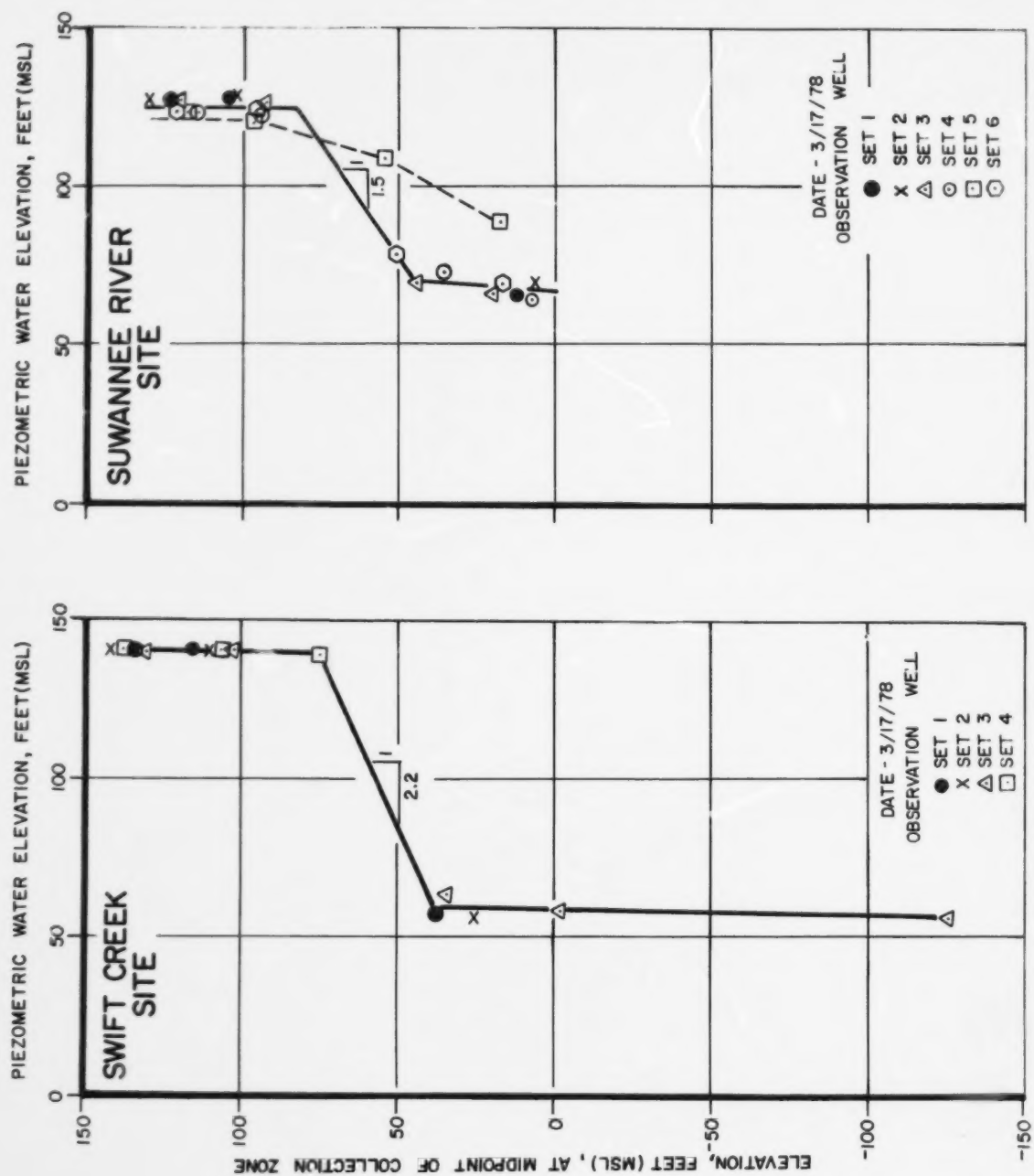
1. COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

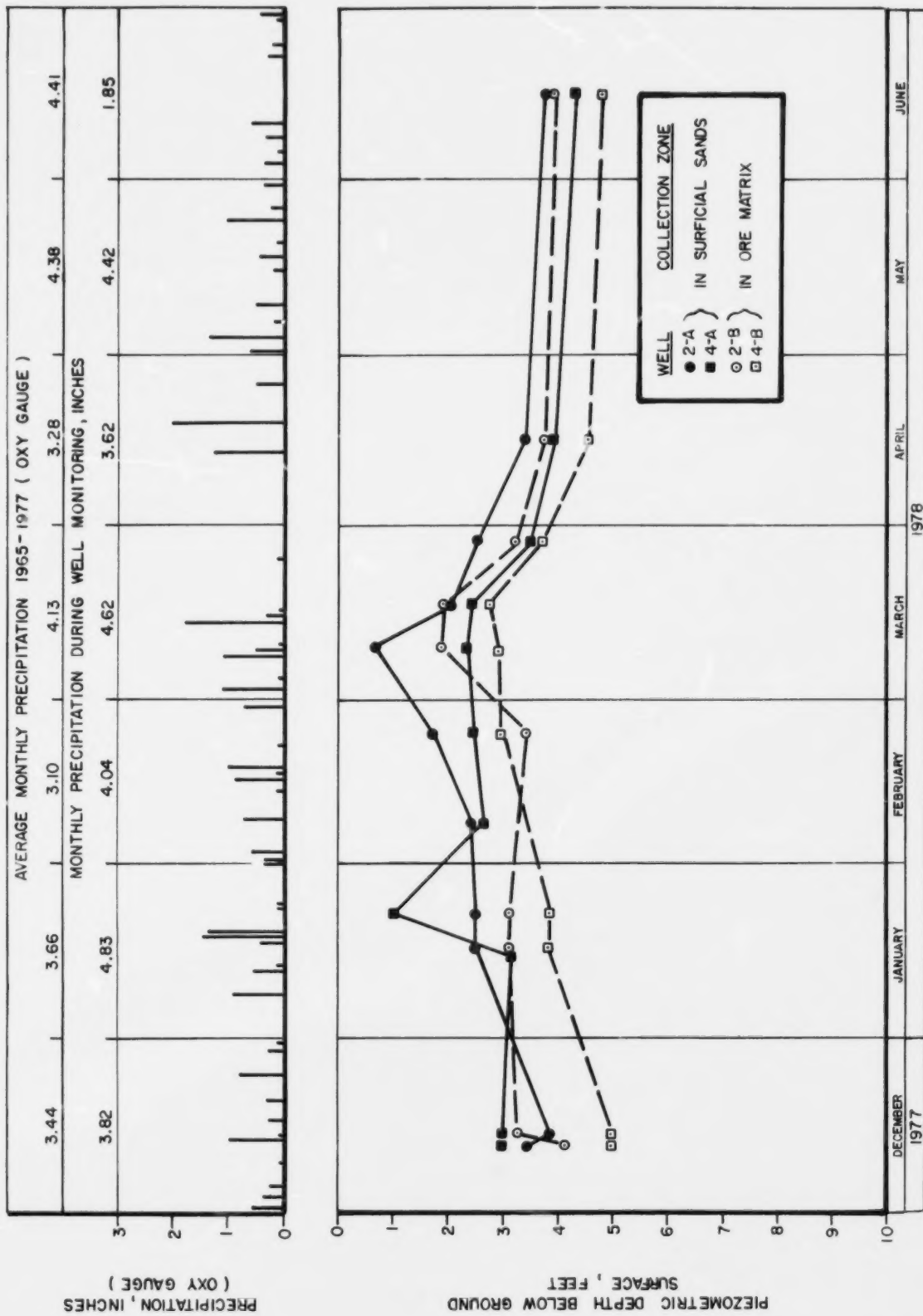
2. COHESIVE SOILS

DESCRIPTION	UNCOFIRMED COMPRESSIVE STRENGTH, Q _u , TST	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM STIFF	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

OBSERVATION WELLS AT EXISTING
WANNEE RIVER CHEMICAL COMPLEX

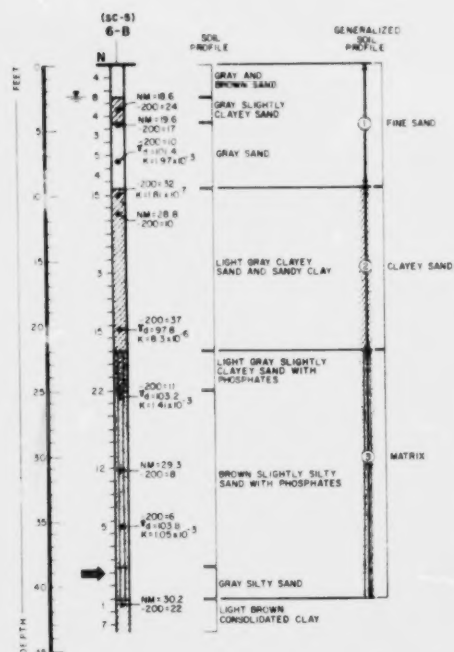
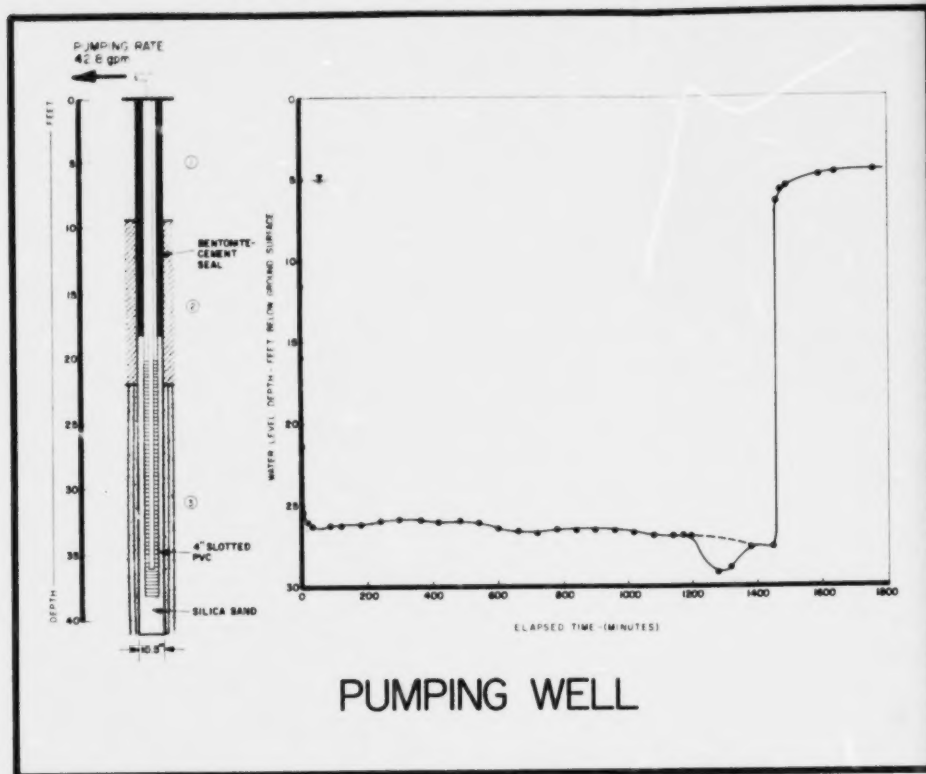
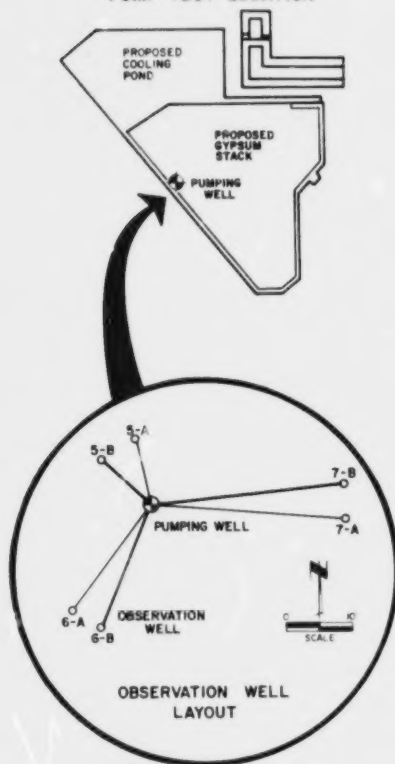


PIEZOMETRIC LEVELS AT VARIOUS DEPTHS IN GEOLOGIC PROFILE

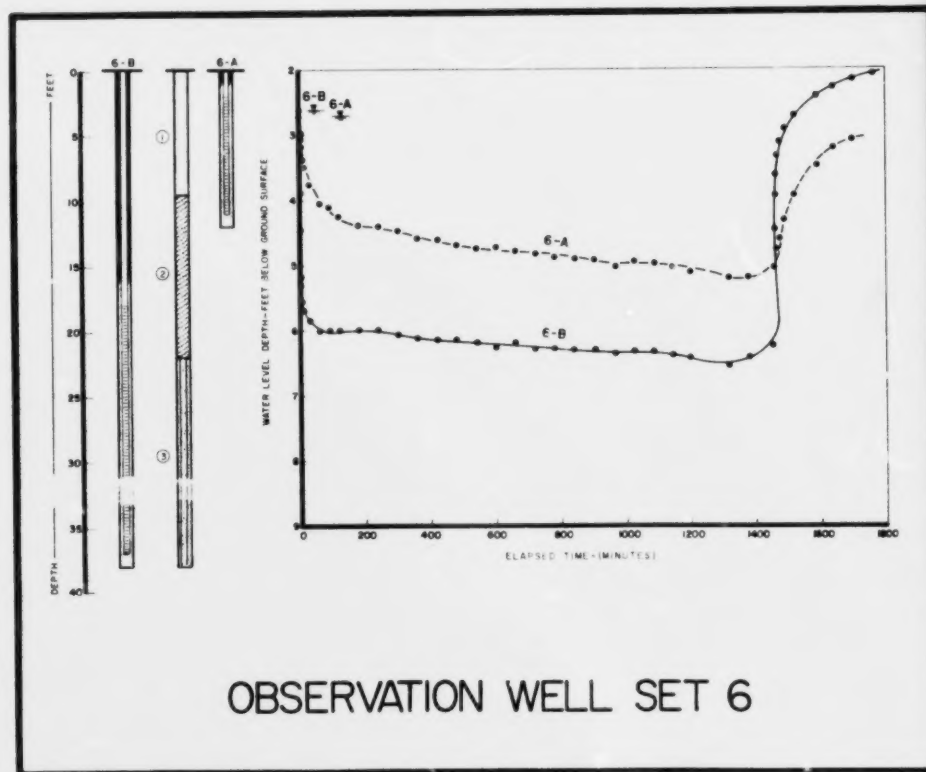


FLUCTUATIONS IN THE GROUNDWATER LEVELS
OF THE SURFICIAL AQUIFER

PUMP TEST LOCATION



SUBSURFACE PROFILE



OBSERVATION WELL SET 6

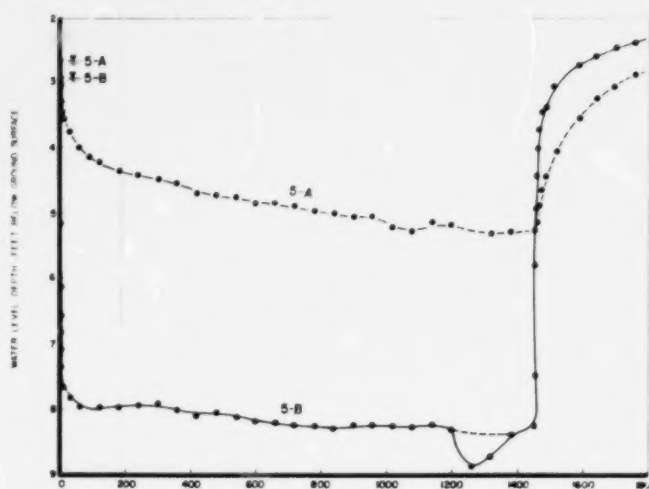
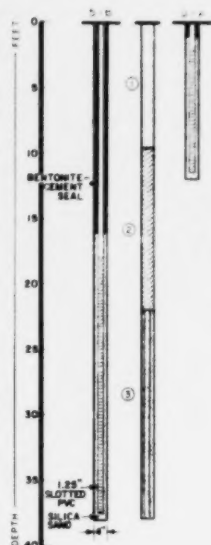
LEGEND			
N	STANDARD PENETRATION RESISTANCE IN BLows PER FOOT	-200	PERCENT PASSING THE US 200 SIEVE
→	LOSS OF DRILLERS FLUID	γ_d	DRY DENSITY, PCF
NM	NATURAL MOISTURE IN PERCENT	K	COEFFICIENT OF PERMEABILITY, cm/sec

SURFICIAL AQUIFER PUMP TEST RES



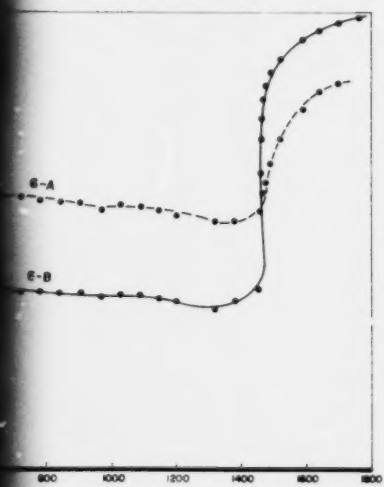
ELAPSED TIME - (MINUTES)

WELL



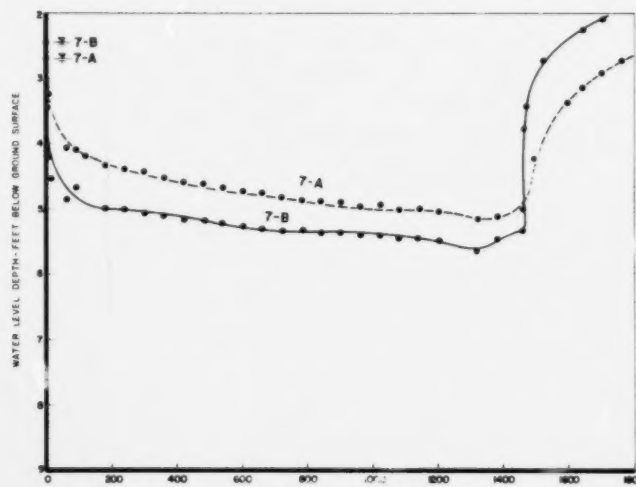
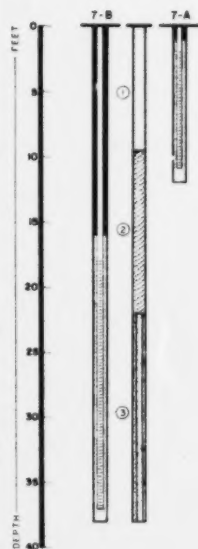
ELAPSED TIME - (MINUTES)

OBSERVATION WELL SET 5



ELAPSED TIME - (MINUTES)

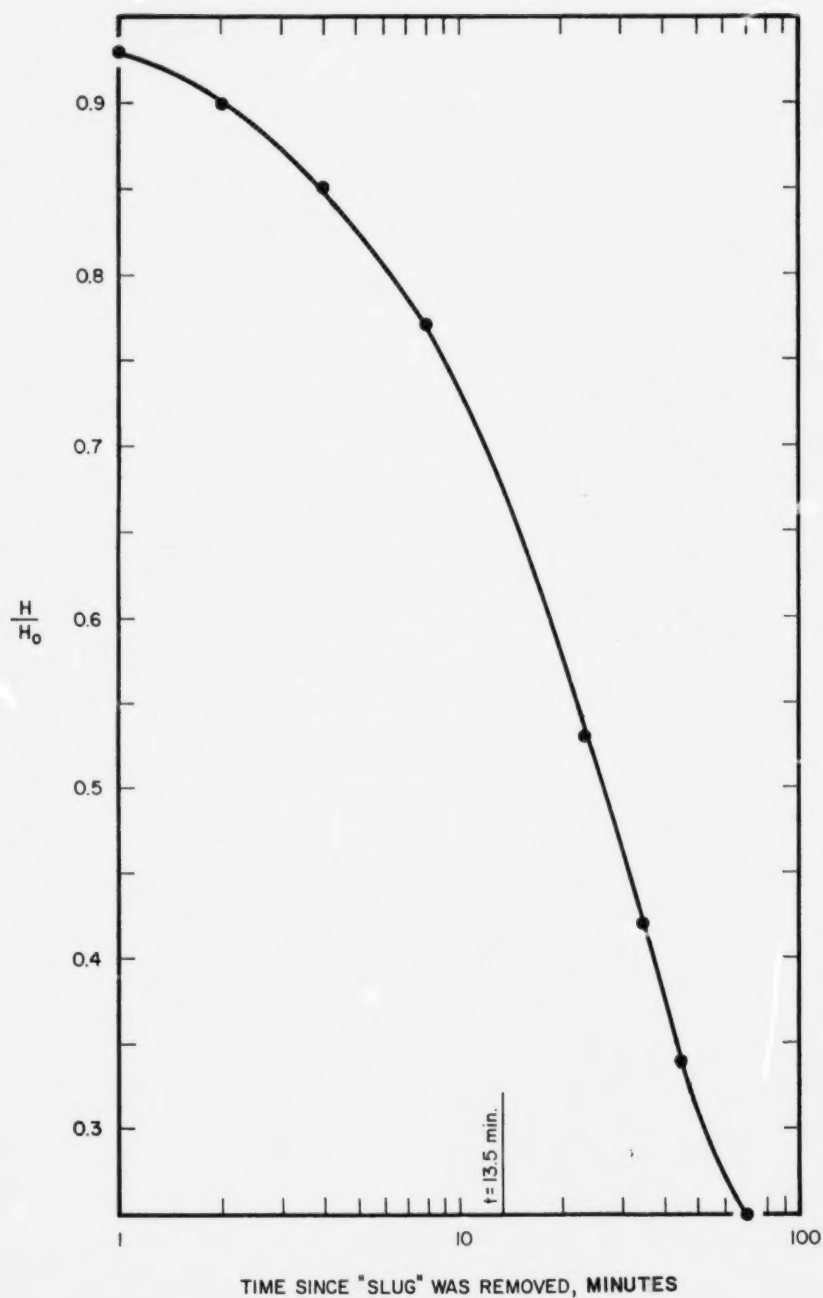
WELL SET 6



ELAPSED TIME - (MINUTES)

OBSERVATION WELL SET 7

AL AQUIFER PUMP TEST RESULTS



WELL 3C (SWIFT CREEK)

$$T = \frac{1.0(r_c^2)}{t} = \text{Transmissivity} = 2.96 \text{ ft}^2/\text{day}$$

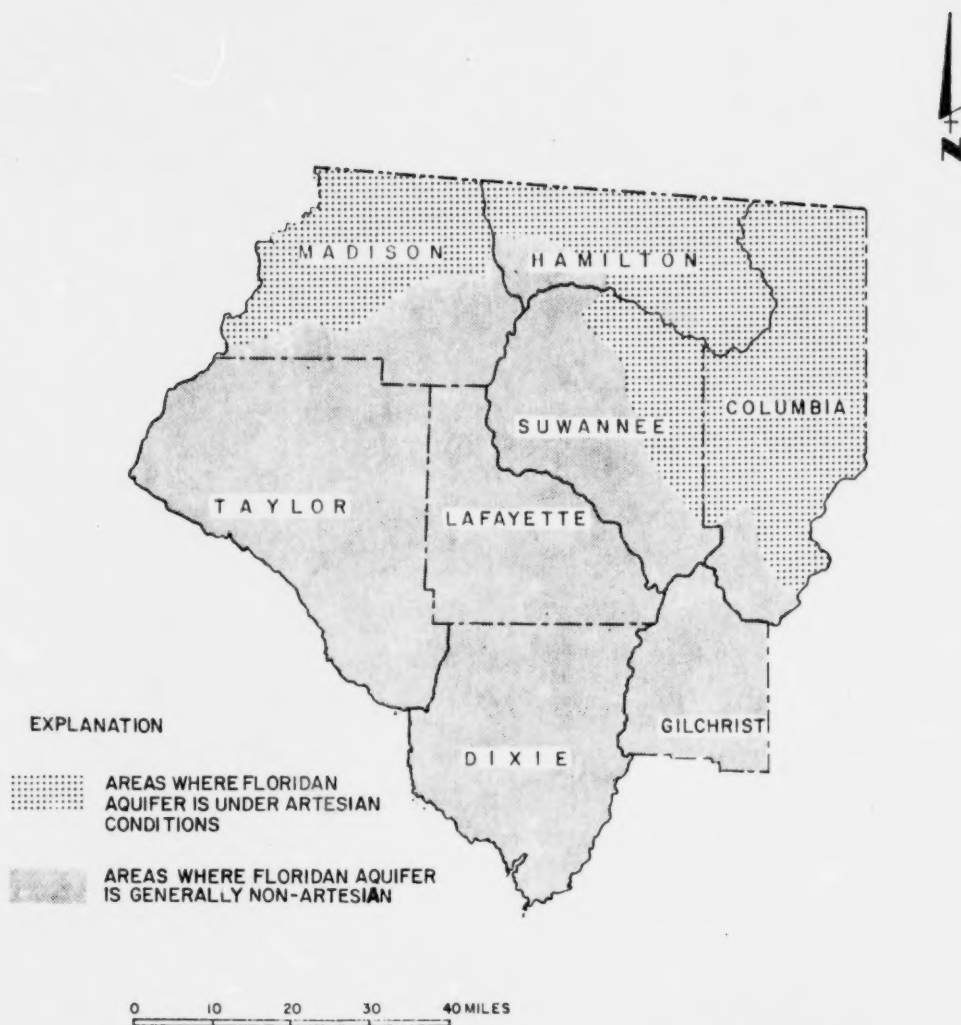
H_0 = Head inside well below initial head at instant of removal of "slug"

H = Head inside well at time t after removal of the "slug", below initial head

r_c = Radius value of well = 2 inches

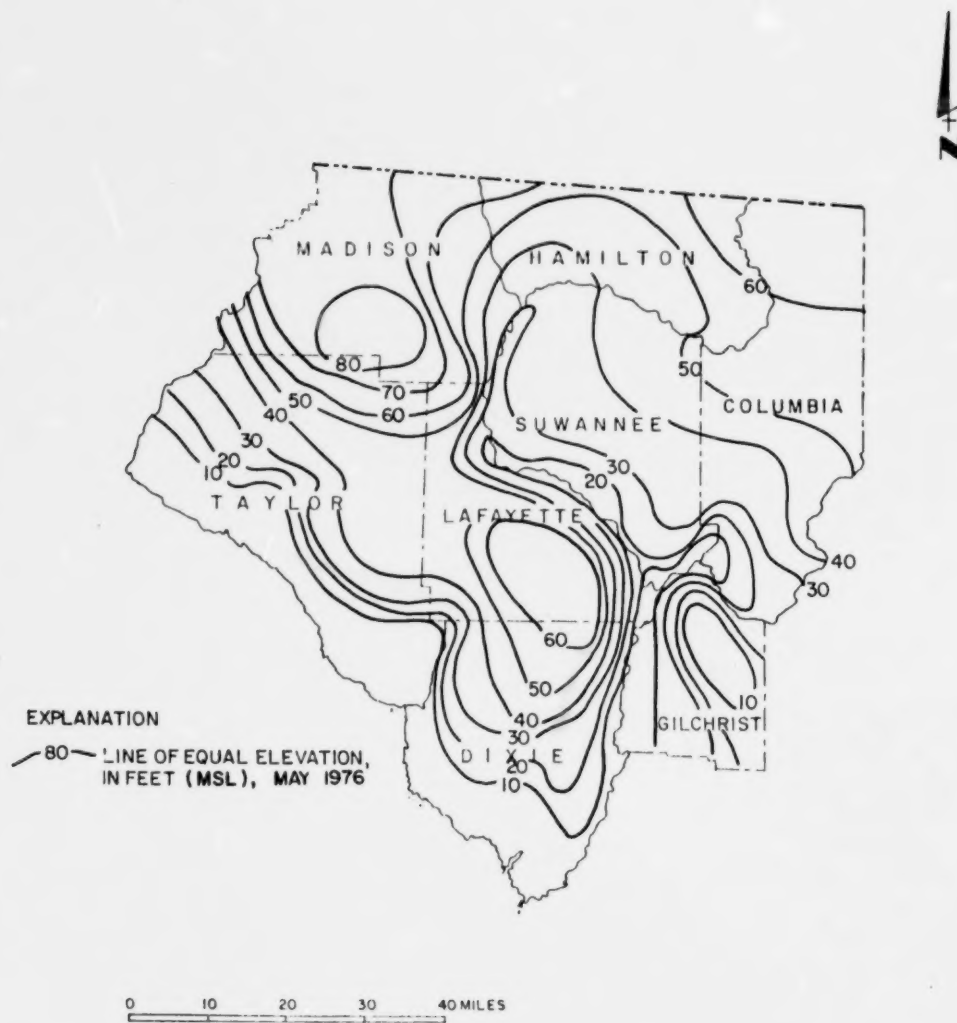
$$t = \text{Time (at } \frac{Tt}{r_c^2} = 1.0) = 13.5 \text{ minutes}$$

SEMI-LOGARITHMIC PLOT OF WATER-LEVEL RECOVERY DATA FROM "SLUG" DISCHARGE TEST IN WELL 3C AT SWIFT CREEK



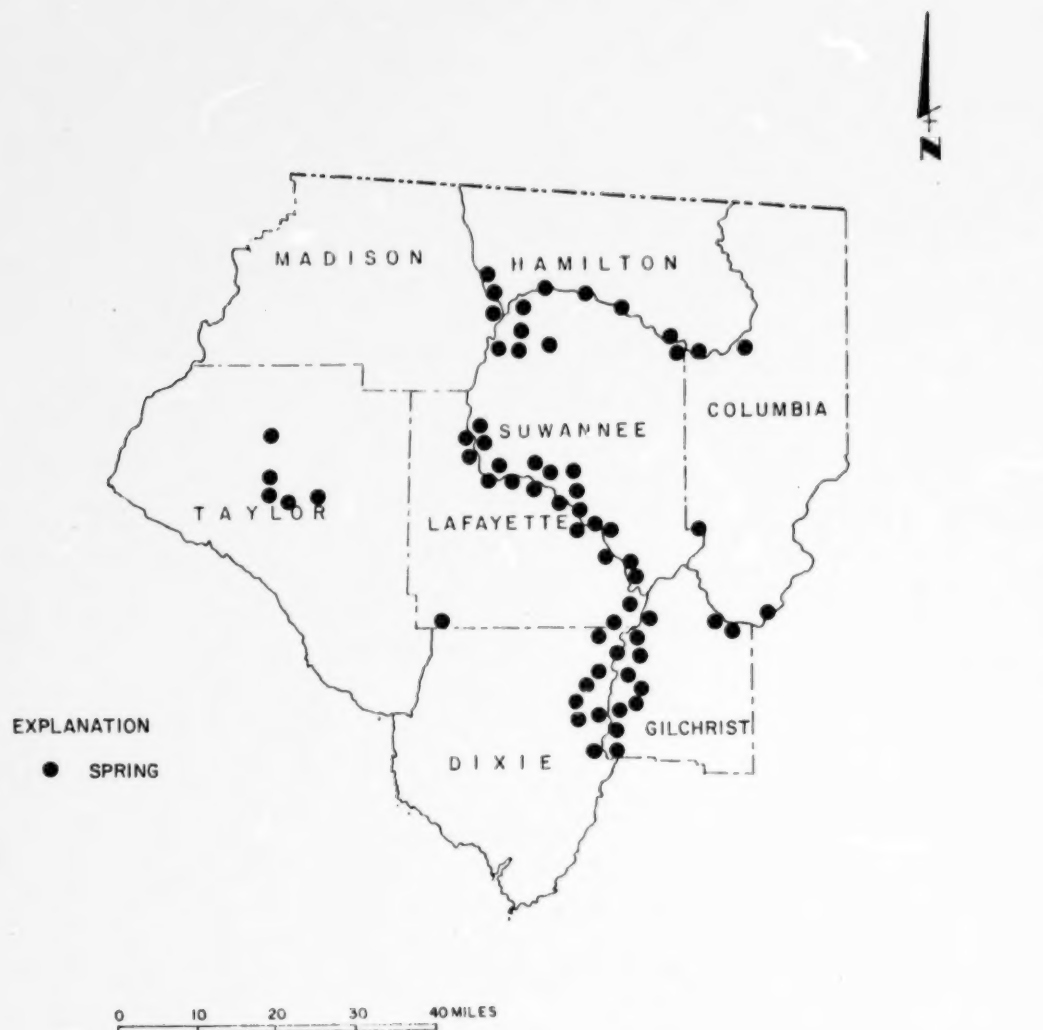
GEOLOGICAL SURVEY, STATE OF FLORIDA, 1967

AREAS WHERE THE FLORIDAN AQUIFER IS UNDER ARTESIAN AND NON-ARTESIAN CONDITIONS

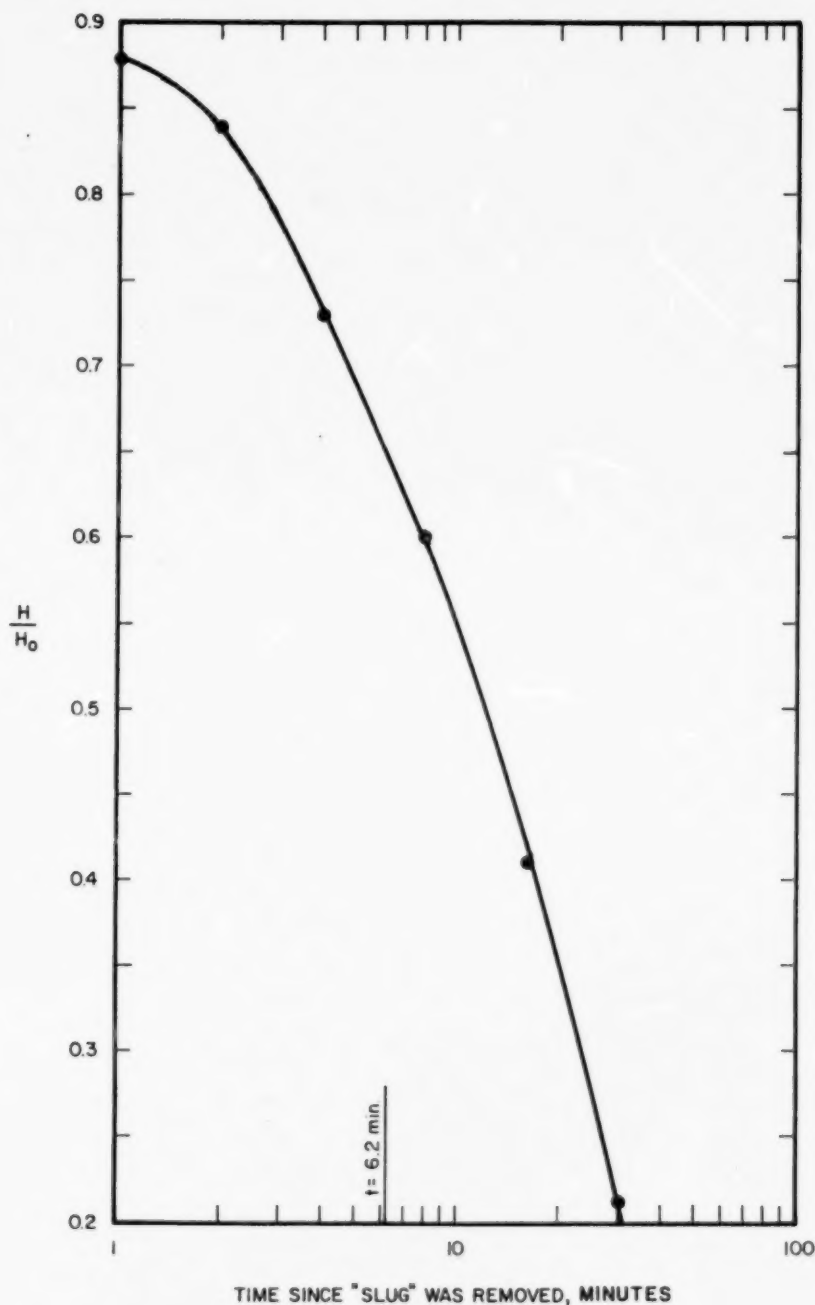


(from Fisk and Rosenau, 1977)

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER



LOCATION OF SPRINGS IN THE REGION



WELL 3D (SWIFT CREEK)

$$T = \frac{10(r_c^2)}{t} = \text{Transmissivity} = 6.45 \text{ ft}^2/\text{day}$$

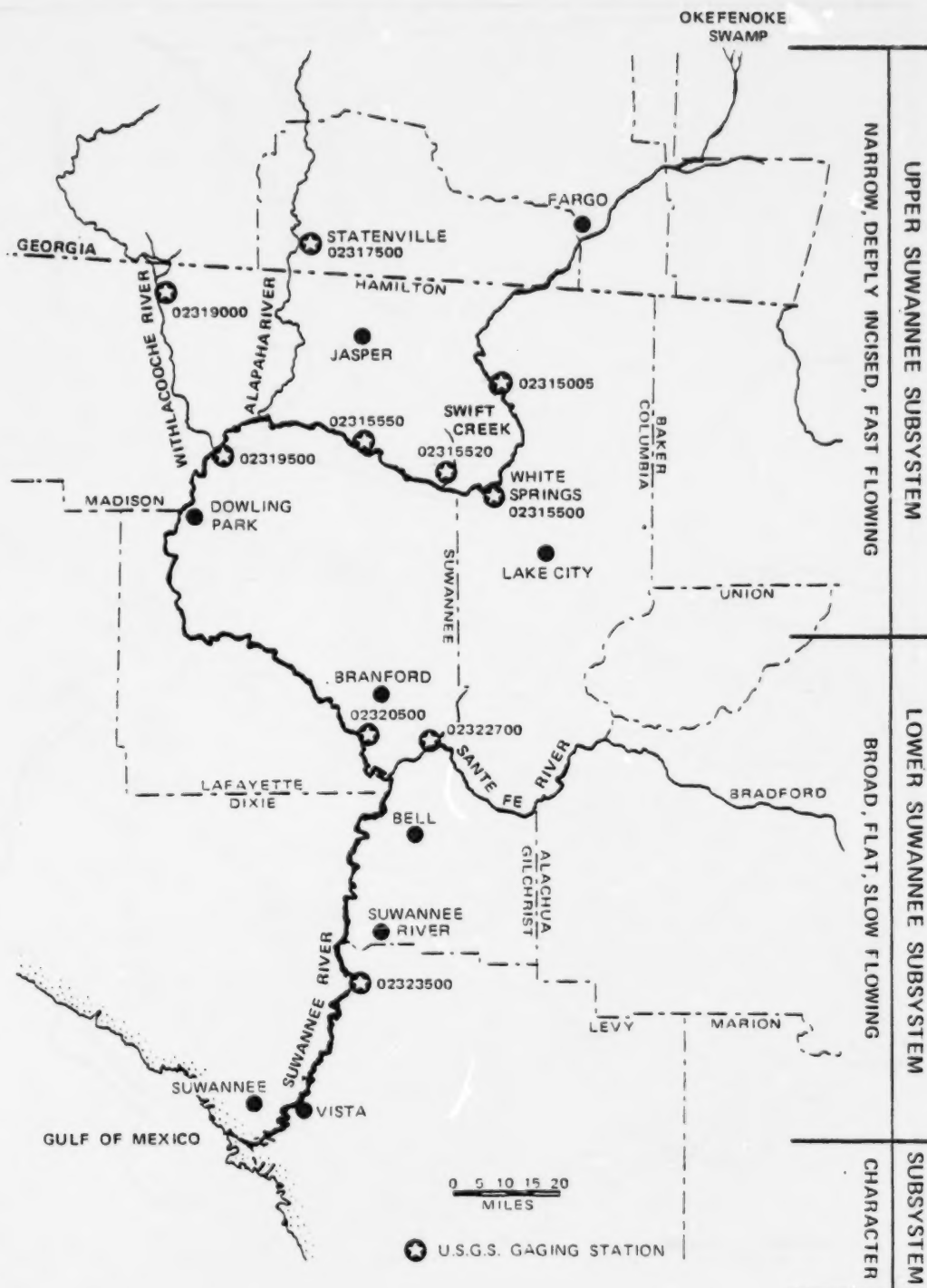
H_0 = Head inside well below initial head at instant of removal of "slug"

H = Head inside well at time t after removal of the "slug", below initial head

r_c = Radius value of well = 2 inches

$$t = \text{Time} \left(\text{at } \frac{Tt}{r_c^2} = 1.0 \right) = 6.2 \text{ minutes}$$

**SEMI-LOGARITHMIC PLOT OF WATER-LEVEL RECOVERY
DATA FROM "SLUG" DISCHARGE TEST IN WELL 3D AT
SWIFT CREEK**



U.S.G.S. STATIONS IN THE SUWANNEE RIVER BASIN

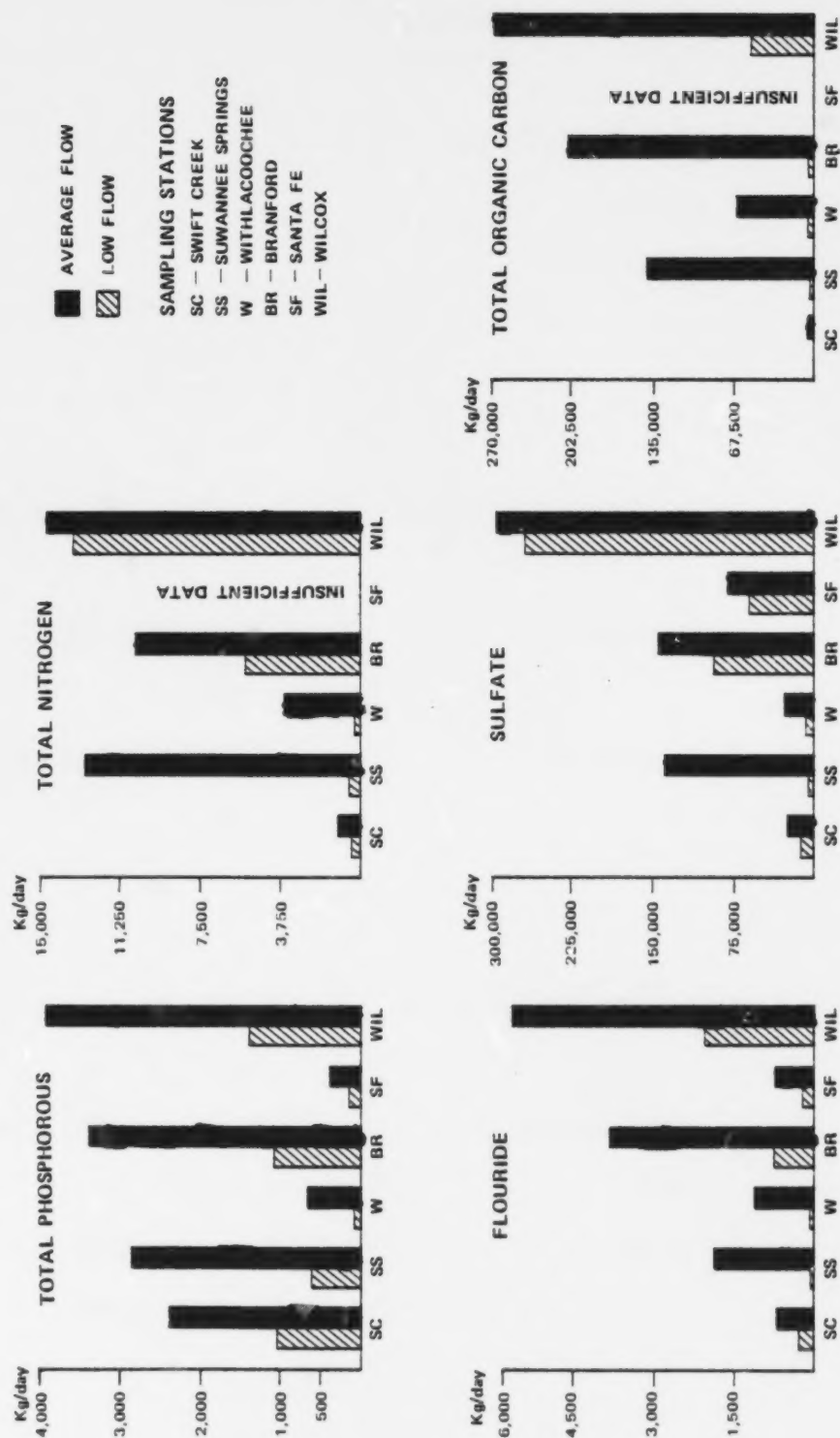


FIGURE 2.6-21

2-305

MASS LOADINGS FOR SELECTED PARAMETERS IN THE SUWANNEE RIVER AND ITS MAJOR TRIBUTARIES

OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX
HAMILTON COUNTY, FLORIDA



SCALE 0 50 100 150 FEET

PROPOSED
COOLING
POND

SET 2

SET 1

SET 3

LEGEND



OBSERVATION WELLS EACH
WITH 3 TO 5 PIEZOMETERS
AT VARYING DEPTHS
(SEE FIGURE 2.6-9)

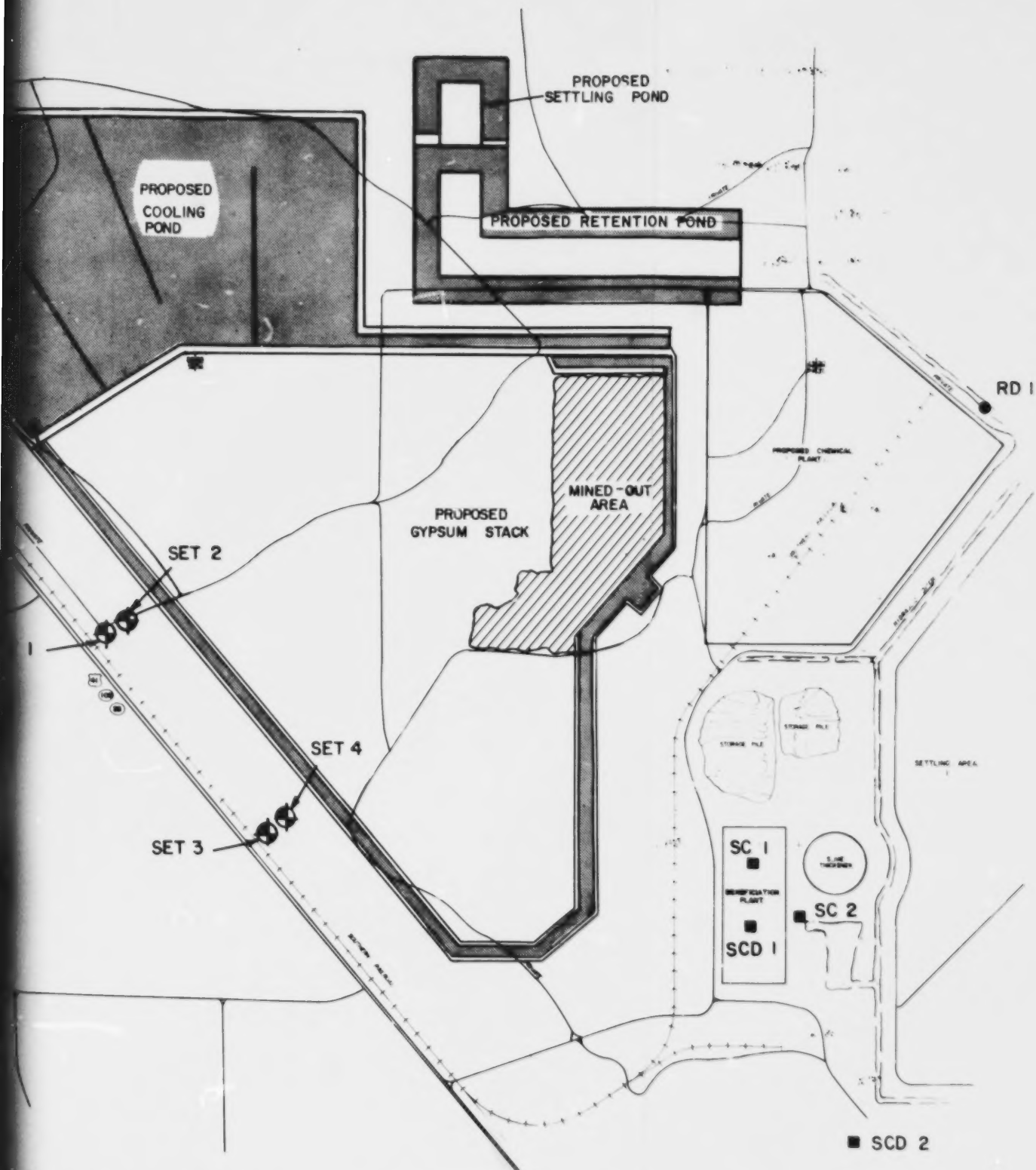


WATER QUALITY SAMPLING
LOCATION

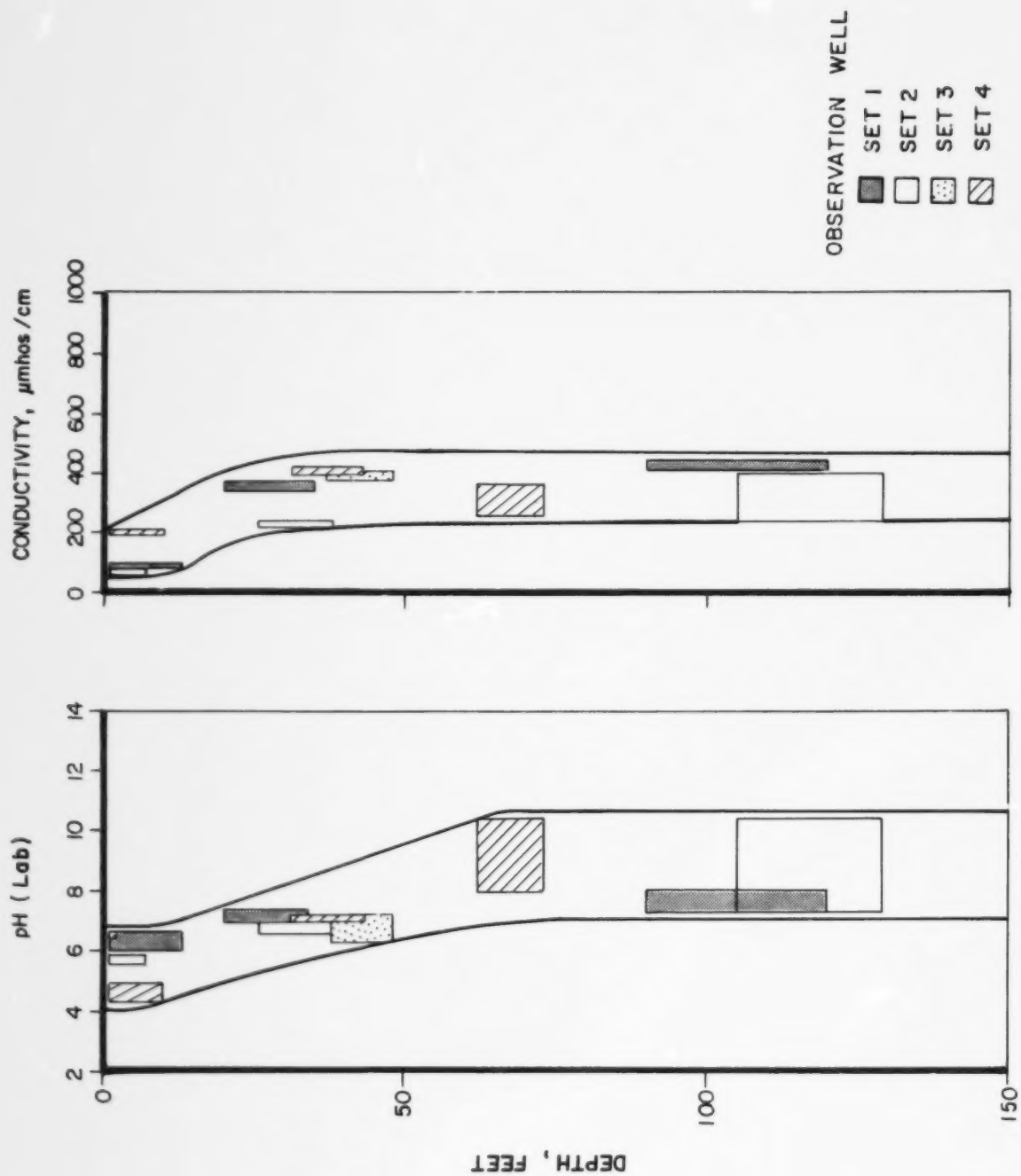


EXISTING WELLS SAMPLED
FOR WATER QUALITY

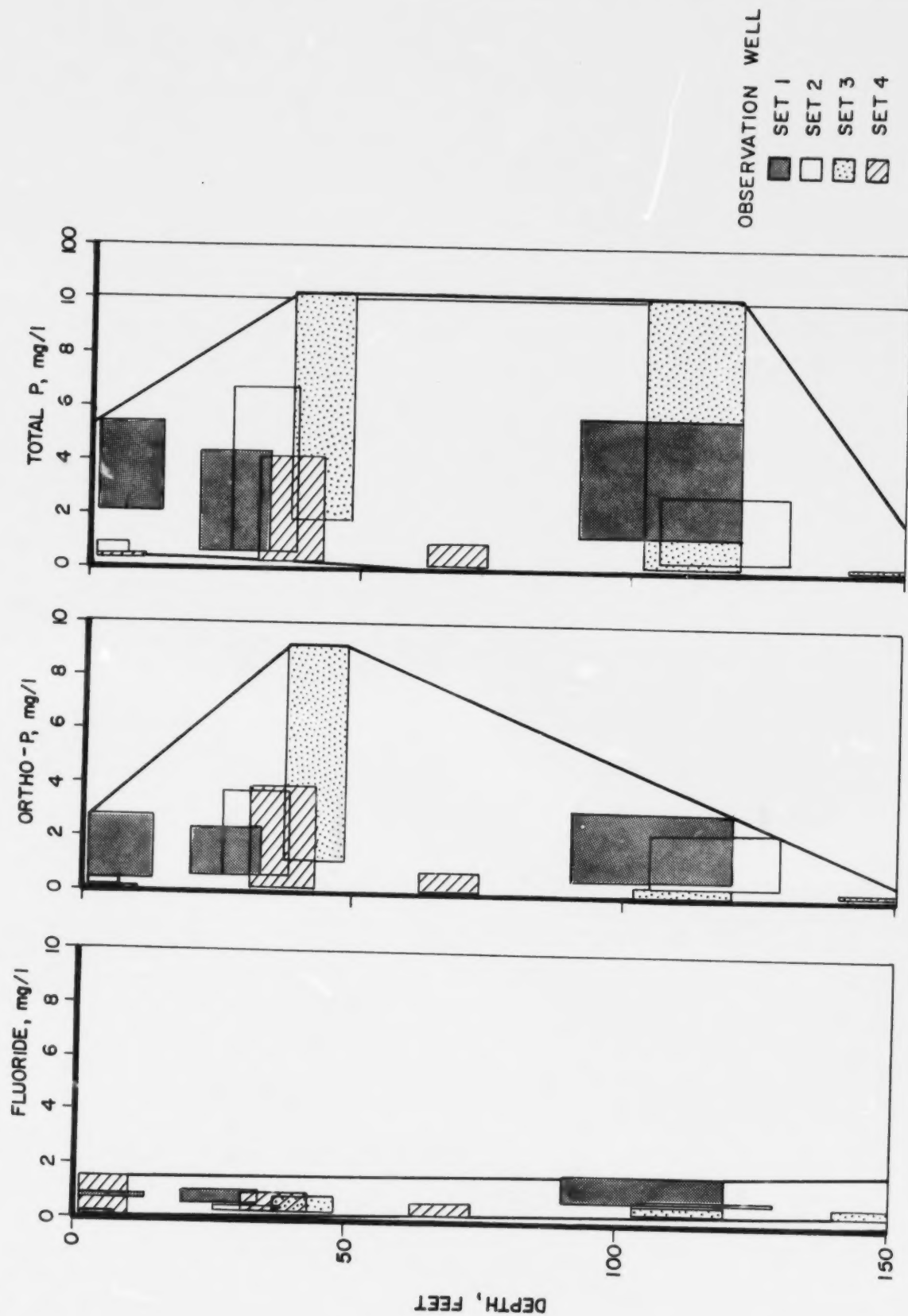
LAYOUT OF MONITORING AND SAMPLING STATIONS



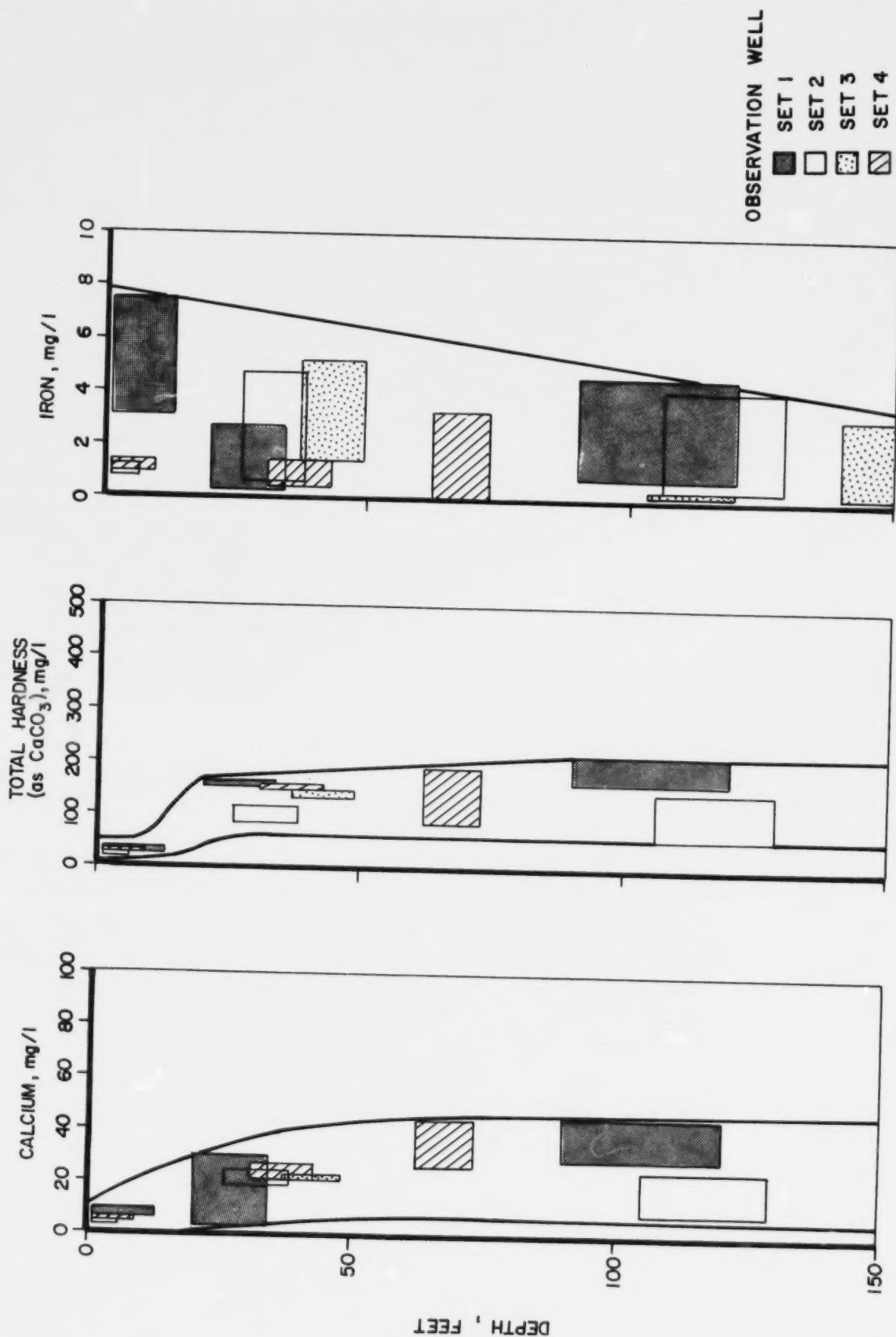
SAMPLING STATIONS (SCCC)



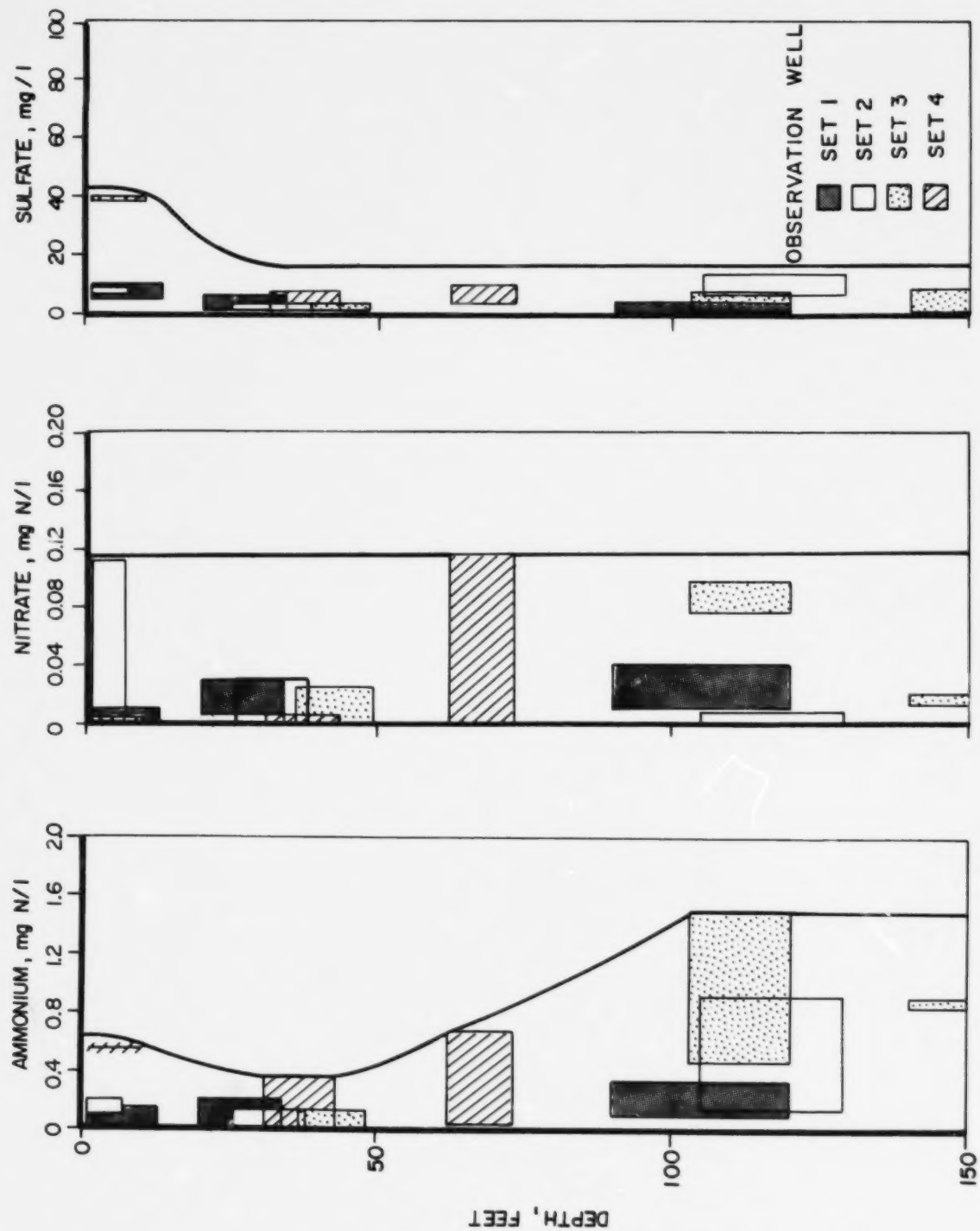
RANGE IN pH AND CONDUCTIVITY
FROM SWIFT CREEK OBSERVATION WELLS



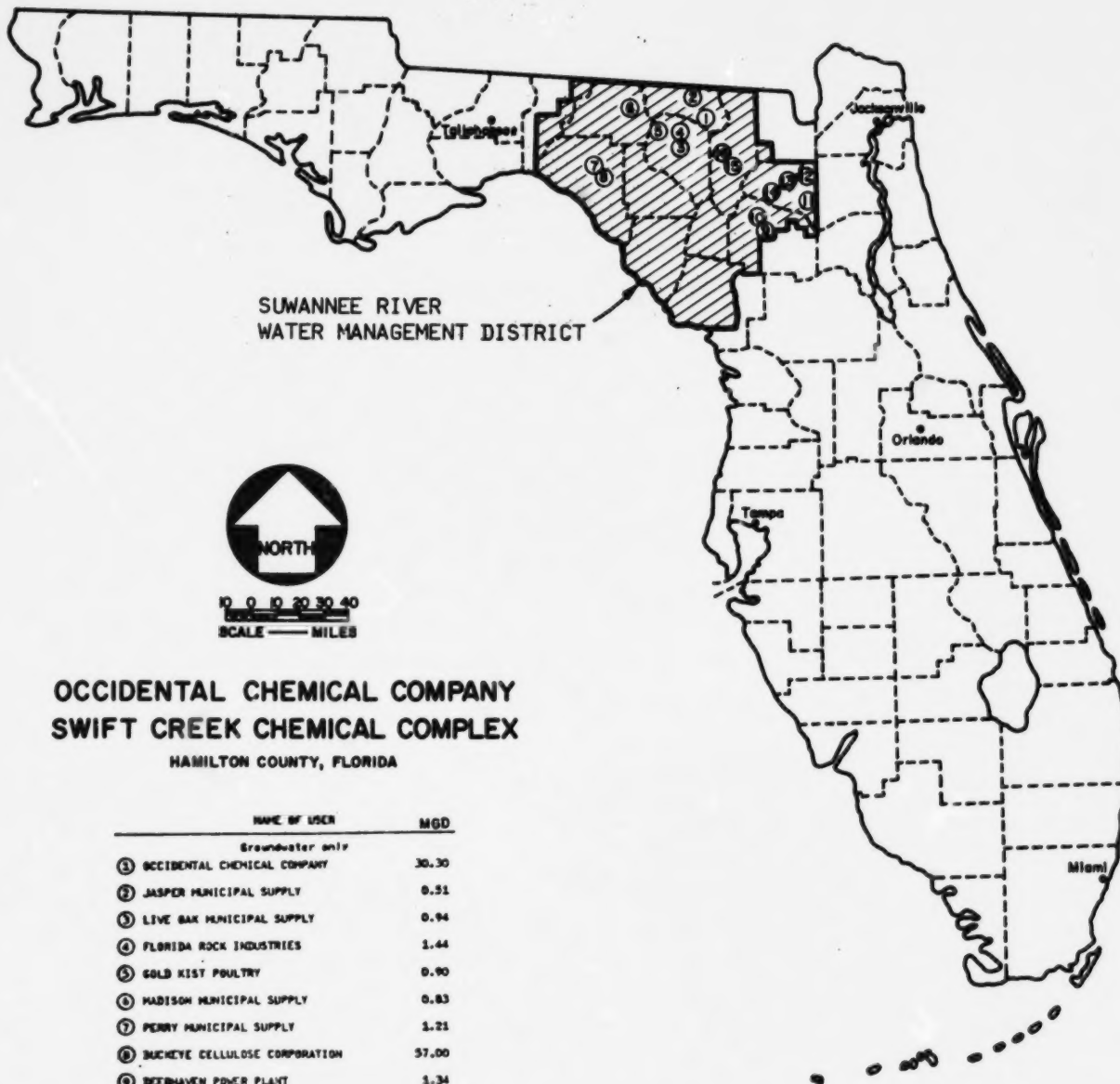
RANGE IN FLUORIDE AND PHOSPHATE CONCENTRATIONS FROM SWIFT CREEK OBSERVATION WELLS



RANGE IN CALCIUM, TOTAL HARDNESS AND IRON
FROM SWIFT CREEK OBSERVATIONS WELLS



RANGE IN AMMONIUM, NITRATE AND SULFATE
FROM SWIFT CREEK OBSERVATION WELLS



NAME OF USER	MGD
Groundwater only	
① OCCIDENTAL CHEMICAL COMPANY	30.30
② JASPER MUNICIPAL SUPPLY	0.51
③ LIVE OAK MUNICIPAL SUPPLY	0.94
④ FLORIDA ROCK INDUSTRIES	1.44
⑤ GOLD KIST POULTRY	0.90
⑥ MADISON MUNICIPAL SUPPLY	0.83
⑦ PERRY MUNICIPAL SUPPLY	1.21
⑧ BUCKEYE CELLULOSE CORPORATION	37.00
⑨ BEEHAVEN POWER PLANT	1.34
⑩ GENERAL ELECTRIC COMPANY	1.80
⑪ STANKE MUNICIPAL SUPPLY	0.69
⑫ E.I. DUPONT BENCHMARKS & CO., INC.	2.59
⑬ FLORIDA STATE PRISON	1.00
⑭ LAKE BUTLER MUNICIPAL SUPPLY	0.54
⑮ LAKE CITY MUNICIPAL SUPPLY	1.64
⑯ U.S. 90 WEST AND I-75 AREA	1.125

Source: SRWMD and USGS data 1975-76
Compiled by: Suwannee River Water Management District

MAJOR GROUNDWATER USERS WITHIN SUWANNEE RIVER WATER MANAGEMENT DISTRICT

APPENDIX

A2.6.1

Flow

A program of monthly flow measurements was conducted between October, 1977 and March, 1978 at each of the water quality stations located on Camps Branch, Hunter, Swift, Rocky and Roaring Creeks. Water velocities were measured with a Marsh-McBirney Model 201 portable water current meter. The meter is accurate to $\pm 2\%$ for water velocities of up to ten feet per second.

Station cross-sections were measured and the total distance across each cross-section was divided into equally spaced sections that were 5% of the total distance. The average depth within each section was determined and the velocity measured. If the depth was less than 1.5 ft., the velocity was measured at a depth of 0.6 the distance from the bottom. If the depth was greater than 1.5 feet, the velocity was measured at 0.2 and 0.8 the distance from the bottom and averaged. Flows and cross-sectional areas within each section were manually integrated to obtain the total flow at each station.

Water Quality

All stations were selected to be representative of general stream conditions and were located upstream of roads, culverts and other features which may have influenced the water quality at each station along Rocky, Hunter, Roaring, Swift, Camps Branch and the Suwannee River.

Water quality analyses determined in situ were dissolved oxygen, temperature, conductivity, pH and oxidation-reduction potential. A YSI Model 57 dissolved oxygen meter equipped with a YSI 5739 D.O. probe and a YSI 5791A submersible stirrer was used for oxygen determinations. A YSI Model 33 S-C-T meter equipped with a YSI 3300 conductivity/temperature probe was used for temperature and specific conductance measurements. An Orion Model 407-A specific ion meter equipped with a Model 910200 and a Model 967800 specific ion electrodes was used to measure pH and redox potential. Manufacturer's directions were followed for each instrument.

Separate collection containers with required preservatives were used for major parameter groups (EPA, 1973). All containers were pre-cleaned and prepared in the laboratory and were rinsed twice with ambient water prior to sample collection. Grab samples were collected in mid-channel at mid-depth when possible. The analytical methods and parameters employed are listed in Table A2.6-1.

Table A2.6-1 Surface Water Quality Parameters.

Parameter	Units	Samples ¹	Method of Analysis
Flow ²	cfs	W	USGS, 1969
Calcium	mg/l	W	SM301 A
Magnesium	mg/l	W	SM301 A
Sodium	mg/l	W	SM320 A
Potassium	mg/l	W	SM317 B
Sulfate	mg/l	W	SM427 A
Chloride	mg/l	W	SM408 B
Fluoride	mg/l	W	SM414 B
Total alkalinity	mg/l as CaCO ₃	W	SM403
Residue filterable	mg/l	W	SM208 C
Residue non-filterable	mg/l	W	SM208 D
Phosphate total	mg P/l	B	SM425 D
Phosphate ortho	mg P/l	B	SM418 B
Ammonia	mg N/l	B	SM418 B
Nitrite	mg N/l	W	SM420
Nitrate	mg N/l	W	SM419 C
Organic nitrogen	mg N/l	B	SM421
BOD	mg/l	W	SM507
Dissolved organic carbon	mg/l	W	SM505
Temperature ²	°C	W	
pH	pH unit	B	SM424
Specific conductivity	µmhos/cm	W	SM205
Dissolved oxygen ²	mg/l	W	SM422 F
Iron	mg/l	B	SM301 A
Manganese	mg/l	B	SM301 A
Hardness	mg/l	W	SM309 A
Color	platinum-cobalt unit	W	SM204 A
Turbidity	NTU	W	SM214 A
Gross alpha radiation	pCi/l	W	SM703
Radium-226	pCi/l	W	SM706
Grease and Oil	mg/l	W	SM502
Arsenic	µg/l	B	SM404 C
Cadmium	µg/l	B	SM305 A
Copper	µg/l	B	SM308 A
Zinc	µg/l	B	SM323 A
Mercury	µg/l	B	SM315 A
Chromium	µg/l	B	SM307 A
Vanadium	µg/l	B	SM322 A
Silica	mg/l	W	SM426 C
Surfactants	mg/l	W	SM512 A
H ₂ S	mg/l	B	SM428 C
Stream sediment particle size		S	Wet Sieve
ORP	mv	S	ASTM D-1498

¹ W= Water samples (collected, preserved, etc. according to EPA, 1974);

B= Water and sediment sample; S= Sediment sample.

² Field measurement.

APPENDIX A2.6.2

GROUNDWATER QUALITY DATA
AT SWIFT CREEK SITE

TABLE A2.6-2

GROUNDWATER QUALITY DATA
SMIFT CREEK SITE
OBSERVATION WELL SET 1

Well Number	1-AA				1-B				1-C			
	1-13'				20-34'				90-120'			
Depth of Collection Zone	W	X	Y	Z	W	X	Y	Z	W	X	Y	Z
Sample Set	2/7/78	2/26/78	4/11/78	4/11/78	1/20/78	2/22/78	4/11/78	4/11/78	2/7/78	2/22/78	4/11/78	4/11/78
Date Sampled	139.6	139.7	139.1	139.1	139.4	139.2	139.1	139.1	68.0	55.9	54.4	54.4
Water Level Elevation	8979	9047	9251	9252	8913	9049	9253	9254	9018	9051	9255	9256
Sample Number	17	15.5	19	19	17.8	--	19	20	18	--	22	22
Temperature °C	0	5	2	2	1	1	0	1	7	4	1	1
Color (APHA Units)	5.5	7.2	6.3	6.4	6.5	7.2	6.8	6.9	6.7	6.8	7.4	--
pH (Field)	6.0	6.1	6.7	6.2	7.1	7.4	6.9	7.1	8.0	7.6	7.5	7.2
NUTRIENTS, mg/l												
Nitrogen-N												
Ammonium	0.06	<0.02	0.13	0.15	0.21	0.20	<0.02	<0.02	0.29	0.34	0.09	0.17
Nitrate	<0.005	<0.005	0.007	0.010	0.013	0.005	0.030	0.007	0.015	0.022	0.040	0.009
Organic Dissolved	<0.02	<0.02	0.07	0.06	0.13	0.12	<0.02	0.02	0.07	0.32	0.11	0.04
Phosphates-P												
Ortho	0.42	2.63	2.80	1.00	2.30	0.54	0.44	0.50	1.32	0.56	1.05	3.20
Total Phosphorus	5.0	5.40	3.97	2.11	4.30	0.620	0.63	0.68	2.64	1.16	1.97	5.65
Dissolved Organic Carbon	7.0	8.5	7.0	6.0	11.5	11.0	8.0	7.5	13.0	12.5	8.0	9.0
MAJOR CONSTITUENTS, mg/l												
Iron	6.10	4.65	7.5	3.1	2.72	0.89	0.31	0.58	2.46	0.80	1.80	4.6
Calcium	12.0	6.2	9.7	3.0	49.0	2.76	30.0	26.6	67.0	45.2	30.2	29.6
Magnesium	2.30	1.95	2.6	2.1	27.2	19.8	21.6	22.9	23.7	24.4	22.1	21.2
Sodium	2.7	3.3	5.1	3.7	3.8	3.7	4.1	4.4	11.0	20.7	15.2	15.0
Potassium	0.8	0.96	0.72	0.24	1.22	0.80	1.43	0.48	1.8	1.9	5.5	7.17
Sulfate	9.7	6.5	10	5.0	1.6	6.2	3.2	2.4	29	3.5	<1.0	<1.0
Sulfides	0.04	0.40	<0.02	<0.02	0.33	0.99	0.15	0.09	0.24	1.09	0.16	0.31
Chloride	5.8	5.0	5.6	5.0	5.4	4.0	6.0	7.1	9.0	7.0	4.8	4.5
Fluoride	0.76	0.89	0.72	0.66	1.10	0.59	0.70	0.64	0.81	1.8	0.91	0.92
Strontium	0.12	0.15	0.06	<0.05	<0.15	<0.13	0.06	<0.05	0.22	<0.13	0.12	0.09
Dissolved Solids	66	78	54	59	176	70	217	181	258	236	332	424
Total Solids	312	332	207	88	632	304	228	200	449	220	812	1280
Hardness (Total)	40	24	35	29	235	151	164	161	265	214	167	161
Alkalinity (CaCO ₃)	26	28	40	33	190	260	135	191	235	222	324	253
Conductivity (µmhos/cm @ 25°C)	82	83	100	83	369	360	352	339	430	409	440	440
TRACE METALS, mg/l												
Arsenic	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium	0.022	0.018	0.008	<0.002	0.033	<0.004	0.003	0.003	0.027	0.010	0.027	0.074
Manganese	0.028	0.012	0.020	<0.002	0.052	0.036	<0.0006	0.020	0.044	0.026	0.044	0.084
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	0.020	0.022	0.021	0.032	0.034	0.009	0.010	0.005	0.076	0.070	0.058	0.104
RADIO-CHEMICAL DATA, pCi/l												
Gross Alpha Radiation	28.1	25.6	--	4.4	29.6	17.3	--	4.5	8.9	3.1	--	13.4
Radium 226	1.5	--	--	--	7.9	2.4	--	--	1.4	--	--	--

Locations shown in Figures 2.6-9 and 2.6-22.

TABLE A2.6-2
(continued)
GROUNDWATER QUALITY DATA
SWIFT CREEK SITE
OBSERVATION WELL SET 2

Well Number	2-A				2-B				2-C			
	1-7'				26-38'				105-129'			
Depth of Collection Zone	W	X	Y	Z	W	X	Y	Z	W	X	Y	Z
Sample Set	1/24/78	2/22/78	4/11/78	4/11/78	1/24/78	2/22/78	4/11/78	4/11/78	5/3/78	2/22/78	4/11/78	4/11/78
Date Sampled	140.4	141.2	139.5	139.1	139.8	139.5	139.1	139.1	53.9	54.8	53.7	53.7
Water Level Elevation	8932	9053	9257	9257	8933	9055	9258	9259	8983	9057	9260	9261
Sample Number	13	18	20	20	20	19	19	21	17	19	22.5	20
Temperature °C	20	6	5	5	7	4.0	0	0	1	5	0	1
Color (APHA Units)	5.7	7.2	5.8	5.8	6.9	7.2	7.6	7.2	10.0	7.2	9.0	8.2
pH (Field)	5.6	5.5	5.9	5.9	5.6	7.0	6.6	6.8	10.4	7.3	9.0	7.6
pH (Lab)												
NUTRIENTS, mg/l												
Nitrogen-N												
Ammonium	--	0.20	0.10	0.10	0.13	0.10	0.08	<0.02	0.91	0.45	0.36	0.13
Nitrate	0.113	0.063	0.010	0.010	0.030	0.008	<0.005	<0.005	<0.005	0.005	0.007	<0.005
Organic Dissolved	--	0.15	0.21	0.21	0.16	0.06	<0.02	0.03	0.3	0.18	0.14	0.12
Phosphates-P												
Ortho	0.072	0.30	0.400	0.400	3.74	0.480	0.500	0.506	2.34	1.38	0.233	0.340
Total	0.940	0.580	0.500	0.500	6.68	0.560	0.50	0.51	2.80	1.74	0.38	0.36
Dissolved Organic Carbon	50.0	12.5	8.0	8.0	32.5	17.0	6.5	6.5	30.5	34.0	7.0	8.5
MAJOR CONSTITUENTS, mg/l												
Iron												
Calcium	0.89	1.20	0.79	0.79	4.70	0.63	1.3	1.0	3.15	4.2	0.47	0.37
Magnesium	6.1	5.0	3.0	3.0	48.0	24.6	18.6	20.1	75.0	24.9	9.1	25.0
Sodium	2.0	2.7	1.3	1.3	16.3	13.0	9.4	11.1	12.5	17.9	8.7	19.7
Potassium	2.1	3.3	4.6	4.6	3.8	3.3	6.5	6.0	30.6	24.8	30.8	24.8
Sulfate	1.02	0.96	0.84	0.84	1.98	0.56	1.43	0.84	22.0	7.8	6.55	3.82
Sulfides	9.3	8.4	7.2	7.2	3.0	3.6	3.7	2.2	34	13	6.2	6.0
Chloride	--	0.74	<0.01	<0.01	0.13	0.14	<0.02	0.17	0.33	1.14	0.15	0.18
Fluoride	3.5	3.0	3.0	3.0	5.5	6.0	6.0	5.0	8.1	7.0	6.0	4.5
Strontium	0.12	0.16	0.18	0.18	0.48	0.34	0.36	0.35	0.96	0.94	0.97	0.88
Dissolved Solids	<0.15	<0.13	<0.05	<0.05	0.42	<0.13	<0.05	<0.05	1.18	0.30	0.14	0.09
Total Solids	132	68	53	53	202	164	142	149	248	250	166	227
Hardness (Total)	260	224	80	80	1020	176	159	158	636	516	245	262
Alkalinity (CaCO ₃)	23	24	13	13	187	115	85	96	239	136	59	146
Conductivity (µmhos/cm @ 25°C)	15	24	11	11	124	150	110	125	201	216	121	203
	60	84	53	53	240	240	217	236	318	395	232	369
TRACE METALS, mg/l												
Arsenic	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium	0.0008	<0.008	0.004	0.004	0.062	<0.004	<0.002	<0.002	0.028	0.018	0.006	0.006
Manganese	0.016	0.018	0.044	0.044	0.069	0.036	0.031	0.030	0.041	0.054	0.013	0.022
Mercury	--	<0.0002	0.0005	0.0005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	0.006	0.018	0.015	0.015	0.066	--	0.068	0.017	0.049	0.13	0.055	0.041
RADIO-CHEMICAL DATA, pCi/l												
Gross Alpha Radiation	5.6	2.7	--	--	21.5	3.4	--	<3.0	18.0	4.5	--	<3.4
Radium 226	0.3	--	--	--	2.4	--	--	--	2.0	--	--	--

Locations shown in Figures 2.6-9 and 2.6-22.

TABLE A2.6-2
(continued)

GROUNDWATER QUALITY DATA
SWIFT CREEK SITE
OBSERVATION WELL SET 3

Well Number	3-B				3-C*				3-J*				3-E			
	37-48'				103-120'				140-156'				243-300'			
Depth of Collection Zone																
Sample Set																
Date Sampled																
Water Level Elevation	139.6	140.2	138.6	138.6	139.6	138.6	138.6	138.6	139.6	138.6	138.6	138.6	139.6	138.6	138.6	138.6
Sample Number	8914	9059	9262	9263	9079	9261	9265	9265	9081	9266	9267	9268	9268	9268	9268	9268
Temperature °C	17.5	17.2	19.5	19.5	19	19	19	19	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
Color (APHA Units)	1	5	5	5	1	1	1	1	1	1	1	1	1	1	1	1
pH (Field)	6.7	--	6.6	6.6	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
pH (Lab)	7.0	6.3	6.9	7.2	13.0	13.0	12.4	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
NUTRIENTS, mg/l																
Nitrogen-N																
Ammonium	0.12	0.11	<0.02	<0.02	1.50	0.99	0.47	0.90	0.84	0.96	0.90	0.20	--	--	--	--
Nitrate	0.025	<0.005	0.007	0.013	0.088	0.076	0.097	0.013	0.157	0.013	0.020	0.010	<0.05	<0.05	<0.05	<0.05
Organic Dissolved	0.11	0.06	0.05	<0.02	0.28	0.27	0.16	0.16	0.04	0.17	0.16	0.09	0.06	0.06	0.10	0.10
Phosphates-P																
Ortho	5.00	1.16	9.20	1.43	0.030	0.373	0.066	0.100	0.100	0.186	0.093	13.47	0.280	0.280	0.160	0.160
Total Phosphorus	5.50	4.00	18.6	1.73	0.080	17.8	0.11	0.11	0.11	0.140	0.24	14.0	0.29	0.29	0.17	0.17
Dissolved Organic Carbon	12.0	10.5	10.5	6.0	13.5	9.0	6.5	6.5	13.0	8.5	10.5	27.5	22.0	22.0	25.0	25.0
MAJOR CONSTITUENTS, mg/l																
Iron	3.08	3.0	5.2	1.4	0.38	0.27	0.22	0.21	0.21	3.2	0.34	107	0.18	0.18	0.28	0.28
Calcium	69.0	20.4	21.3	22.4	212	494	247	291	291	288	335	92.97	63.0	63.0	61.0	61.0
Magnesium	25.8	19.8	18.8	21.6	0.13	<0.10	1.2	0.13	0.13	0.20	<0.10	30.9	24.4	24.4	25.4	25.4
Sodium	5.2	8.3	9.7	8.5	516	320	423	84.6	84.6	62.1	48.3	10.3	12.4	12.4	9.9	9.9
Potassium	1.42	1.6	2.39	0.84	1660	865	170	51.2	51.2	100	63.7	3.2	5.98	5.98	6.6	6.6
Sulfate	2.4	3.4	1.8	1.8	7.0	3.4	<1.0	8.4	8.4	<1.0	6.2	22	14	14	13	13
Sulfides	0.37	0.31	0.36	0.18	0.45	0.24	0.12	0.45	0.45	<0.02	0.27	0.63	1.08	1.08	1.23	1.23
Chloride	7.1	6.0	7.6	7.1	4.0	1.5	3.5	3.0	3.0	1.5	3.5	7.0	6.6	6.6	6.6	6.6
Fluoride	0.67	0.84	0.32	0.28	0.69	0.42	0.79	0.46	0.46	0.77	0.74	0.50	0.43	0.43	0.42	0.42
Strontium	<0.15	0.18	0.06	<0.05	18.0	24.9	10.2	3.60	3.60	4.5	3.2	0.20	0.15	0.15	0.09	0.09
Dissolved Solids	196	184	239	263	3370	3660	1620	1000	1000	951	880	246	317	317	322	322
Total Solids	514	412	686	326	3720	3720	1710	1100	1100	1270	904	694	356	356	334	334
Hardness (Total)	279	133	131	145	531	1240	622	728	728	721	838	360	258	258	262	262
Alkalinity (CaCO ₃)	204	209	202	203	3000	3140	1520	1010	1010	966	878	404	255	255	268	268
Conductivity (µmhos/cm @ 25°C)	406	397	380	370	13500	13000	5820	4000	4000	4000	3670	510	470	470	480	480
TRACE METALS, mg/l																
Arsenic	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	0.04	0.04	0.04
Chromium	0.026	0.022	0.046	0.010	0.022	0.026	0.011	0.008	0.008	0.014	0.007	0.108	0.003	0.003	0.004	0.004
Manganese	0.088	0.079	0.084	0.053	0.022	0.013	0.014	0.014	0.014	0.067	0.008	0.1857	0.041	0.041	0.056	0.056
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	0.026	0.027	0.071	0.020	0.078	0.144	0.046	0.028	0.028	0.089	0.250	0.076	0.105	0.105	0.094	0.094
RADIO-CHEMICAL DATA, pCi/l																
Gross Alpha Radiation	13.0	3.5	--	3.0	--	--	--	--	--	--	10.6	16.2	--	--	33.9	33.9
Radium 226	4.2	--	--	--	--	--	--	--	--	--	--	3.7	--	--	--	--

*Values reflect contamination from cement grouting (e.g., pH, conductivity, calcium, total hardness....).
Locations shown in Figures 2.6-9 and 2.6-22.

TABLE A2.6-2
(continued)GROUNDWATER QUALITY DATA
SWIFT CREEK SITE
OBSERVATION WELL SET 4

Well Number	4-A			4-B			4-C		
	1-10'			31-43'			62-73'		
Depth of Collection Zone									
Sample Set									
Date Sampled	1/24/78	2/23/78	4/12/78	2/23/78	4/12/78	4/12/78	2/23/78	4/12/78	4/12/78
Water Level Elevation	142.2	140.8	138.7	139.4	138.7	138.7	137.8	137.6	137.6
Sample Number	8936	9061	9062	8916	9270	9271	8985	9272	9273
Temperature °C	13	14	17.8	17.8	20	21	19	21	21
Color (APHA Units)	150	180	2	2	7	0	1	0	0
pH (Field)	4.8	--	6.7	6.7	6.7	6.8	9.6	10	8.6
pH (Lab)	4.3	4.9	7.1	7.1	7.0	7.0	10.4	10.4	7.4
NUTRIENTS, mg/l									
Nitrogen-N									
Ammonium	--	0.57	0.13	0.05	0.36	<0.02	0.67	0.20	0.01
Nitrate	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	0.117	0.115	<0.005
Organic Dissolved	--	1.05	0.09	0.18	0.10	0.02	1.12	0.08	0.04
Phosphates-P									
Ortho	0.030	0.080	2.37	3.88	0.200	0.130	0.05	0.74	0.806
Total Phosphorus	0.452	0.404	3.02	4.15	0.35	0.27	0.06	0.920	0.83
Dissolved Organic Carbon	59.0	62.5	13.0	23.5	5.0	4.5	68.0	32.0	6.0
MAJOR CONSTITUENTS, mg/l									
Iron	0.90	1.4	1.38	0.96	0.70	0.37	0.03	2.2	0.80
Calcium	9.9	5.1	53.0	24.3	26.6	21.3	16.0	26.1	44.2
Magnesium	4.8	4.3	24.2	21.6	21.6	22.6	12.8	18.5	19.3
Sodium	14.1	21.5	4.9	6.8	7.8	6.0	8.5	9.1	5.3
Potassium	4.10	8.9	0.98	1.6	0.84	0.06	5.4	3.7	2.63
Sulfate	39	40	2.2	3.2	7.7	3.1	48	6.2	3.6
Sulfides	--	0.36	0.28	0.37	0.26	0.06	0.08	0.39	0.11
Chloride	27	23	6.1	6.0	7.1	7.1	8.1	5.5	7.6
Fluoride	1.5	0.16	0.44	1.0	0.34	0.31	0.25	0.48	0.42
Strontium	<0.15	<0.13	<0.15	0.18	0.06	<0.05	0.44	0.35	0.05
Dissolved Solids	292	200	250	270	291	224	92	170	214
Total Solids	558	549	458	634	304	232	154	748	294
Hardness (Total)	45	30	232	150	155	146	93	141	88
Alkalinity (CaCO ₃)	0.0	5.0	212	230	215	222	62	176	194
Conductivity (µmhos/cm @ 25°C)	200	200	415	412	406	392	250	330	348
TRACE METALS, mg/l									
Arsenic	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium	0.006	0.006	0.008	0.006	<0.0002	<0.0002	0.014	0.014	0.004
Manganese	0.031	0.028	0.062	0.054	0.039	0.032	<0.002	0.386	0.031
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0003
Zinc	0.008	0.026	0.020	0.019	0.012	<0.004	0.015	0.029	0.008
RADIO-CHEMICAL DATA, pCi/l									
Gross Alpha Radiation	9.8	3.0	4.5	1.9	--	3.5	<2.3	<2.7	<2.1
Radium 226	3.4	--	0.1	--	--	--	0.4	--	--

Locations shown in Figures 2.6-9 and 2.6-22.

TABLE A2.6-3

GROUNDWATER QUALITY DATA
SWIFT CREEK SITE
EXISTING WELLS AND MISCELLANEOUS SITES

Well Number	OXY Shallow Potable Wells					OXY Deep Production Wells					Return Water Ditch				
	SCD-1					SC-1					RD-1				
	168-270'					180-800'					186-800'				
Depth of Collection Zone	3/1/76	1/18/78	2/23/78	4/13/78	4/19/78	3/1/76	11/15/74	3/1/76	4/19/78	6/30/75	1/18/78	2/78/78	4/12/78	1/18/78	4/19/78
Date Sampled	3/1/76	1/18/78	2/23/78	4/13/78	4/19/78	3/1/76	11/15/74	3/1/76	4/19/78	6/30/75	1/18/78	2/78/78	4/12/78	1/18/78	4/19/78
Sample Number	8099	9072	9277	9277	9378	8099	8099	8099	8099	8099	8099	8099	8099	8099	8099
Temperature °C	21	19	21	21	19.5	21	21	21	21	21	21	21	21	21	21
Color (APHA Units)	10	0	2	1	0	15	6	15	2	0	7	7	10	12	22
pH (Field)	--	6.7	--	7.1	--	--	--	--	--	--	--	--	7.2	6.7	5
pH (Lab)	7.6	7.5	7.4	7.8	6.8	7.1	7.5	6.4	7.1	7.6	7.4	7.2	7.9	7.8	6.9
NUTRIENTS, mg/l															
Nitrogen-N	--	0.50	0.27	0.05	<0.02	--	--	--	0.09	--	0.47	0.07	0.02	0.17	0.27
Ammonium	--	0.012	0.007	0.010	0.007	--	--	0.12	0.038	--	0.007	0.007	0.013	0.008	0.030
Nitrate	--	0.26	0.23	0.23	0.31	--	--	--	0.19	--	0.37	0.08	0.22	0.56	0.34
Organic Dissolved	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phosphates-P	--	0.318	0.08	0.053	0.356	--	--	--	0.228	--	0.140	0.200	0.093	0.615	0.663
Ortho	--	0.450	0.140	0.15	0.46	--	1.6	--	0.32	0.9	0.160	0.200	0.13	0.685	0.92
Total Phosphorus	--	6.0	16.5	3.0	71.0	--	--	--	10.0	--	9.0	11.5	5.0	13.0	41.0
Dissolved Organic Carbon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MAJOR CONSTITUENTS, mg/l															
Iron	0.06	0.06	0.12	0.09	1.1	1.1	0.1	0.60	1.1	0.2	0.14	0.92	0.38	0.36	0.93
Calcium	70	68.0	63.8	65.3	54.7	66	2	62	54.7	60	51.0	55.3	54.7	36.0	25.5
Magnesium	25	29.6	27.6	25.9	24.4	17	20	20.8	24.4	24	20.8	18.2	18.8	13.5	12.9
Sodium	8.9	7.4	20.7	11.3	3.8	3.2	13	8.5	10.1	9.4	7.3	24.6	12.0	7.7	5.1
Potassium	1.3	1.14	1.2	0.96	0.60	0.87	--	1.9	0.84	--	3.44	1.0	1.2	1.54	0.84
Sulfate	22	11	11	9.8	<1.0	14	48	127	28	35	26	21	23	38	16
Sulfides	--	0.49	0.38	0.14	0.29	--	--	0.36	<0.02	--	1.5	0.53	0.96	0.58	0.30
Chloride	15	10	8.1	8.6	4.5	12	0.7	18	11	3	12.0	8.8	9.1	14	9.5
Fluoride	0.36	0.32	0.32	0.33	0.42	0.38	0.6	1.6	0.39	0.5	0.37	0.34	0.38	1.2	1.20
Strontium	--	<0.15	0.15	0.07	0.06	--	--	--	0.06	--	<0.15	0.18	0.08	<0.15	<0.05
Dissolved Solids	--	282	288	380	258	--	421	--	248	360	344	264	302	170	210
Total Solids	344	478	332	382	297	--	--	--	260	--	402	276	310	329	226
Hardness (total)	276	292	273	270	237	--	264	--	222	--	213	213	214	139	117
Alkalinity (CaCO ₃)	265	278	273	277	252	--	228	--	210	--	199	192	192	127	118
Conductivity (µmhos/cm @ 25°C)	--	538	506	467	435	--	--	--	433	--	450	400	368	349	263
TRACE METALS, mg/l															
Arsenic	--	<0.02	<0.02	<0.02	<0.02	--	--	--	<0.02	--	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium	--	<0.013	<0.004	<0.002	0.003	--	--	--	0.009	--	<0.003	<0.004	<0.002	<0.003	0.007
Manganese	--	0.016	0.024	0.031	0.104	--	<0.05	--	0.041	<0.05	0.042	0.036	0.036	0.010	0.026
Mercury	--	<0.0002	<0.0002	<0.0002	<0.0002	--	--	--	<0.0002	--	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Zinc	--	0.006	0.055	0.022	4.3	--	--	--	0.048	--	<0.004	0.012	0.010	0.045	0.007
RADIO-CHEMICAL DATA, pCi/l															
Gross Alpha Radiation	--	<2.1	1.9	<3.1	<1.2	--	--	--	<1.4	--	5.8	<1.8	<1.6	7.2	3.4
Radium 226	--	0.9	--	--	--	--	--	--	--	--	0.5	--	--	0.3	--

*Orlando Laboratories; Orlando

**Thornton Laboratories; Tampa

All other water quality data from Black, Crow & Edsness; Gainesville
Locations shown in Figure 2.6-22.

APPENDIX A2.6.3

WELL INVENTORY

TABLE A2.6-4
WELL INVENTORY

EIS Well Number	USGS Type Well Number	Local Number	Depth	Casing Depth, ft./ Diameter, in.	Use	Year Drilled	Owner	Elevation Of Well (Ft. MSL)
1	295707N0823937	0651624-1 77962	130'	98/4	Domestic	1974	C.S. Patrick	100+
2	295857N0825241	0651411-1	--	-/4	--	--	Branford Vet Clinic	51+
3	300138N0825627	--	40'	40' curbed/ 3'x3' (Dug)	Domestic	--	W. E. Roberts	50.8
4	300400N0825850	--	136'	24/4	Domestic	--	Valmont Farms	57+
5	300542N0823321	04S1831-1 17342	140'	121/4	Domestic	1974	W. H. Malloy	143+
6	300752N0824739	04S1523-1 4298	120'	87/4	Domestic	1974	William Mosely	106.6
7	300824N0830431	--	120'	60' /8	Irrigation	--	Curtis Johnson	60.5
8	300936N0824845	--	996'	545/10	Irrigation	--	Pete Giebief	119.4
9	301031N0823810	Columbia Co. Number 9	836'	680/12	Unused	--	City of Lake City	143.6
10	301100N0823542	--	--	--	--	--	Florida Division of Forestry	--
11	301122N0824200	47404	120'	101	--	--	Otis Privette, Jr.	--
12	301149N0825938	--	180'	50/10	Irrigation	--	J. A. Croft	101.9
13	301209N0824254	35697	120'	102	--	--	Jack Hampton	--
14	301241N0823806	2-20	160'	140	--	--	John Lee	--
15	301249N0825555	035-1420-1	190'	--	--	--	Lillie May Boone	179.5
16	301358N0830852	--	129'	104/8	Irrigation	--	V. V. Brim	91.1
17	301424N0823308	--	--	--	--	--	--	--
18	301440N0824523	4255	160'	141	--	--	Rufus Ogden	--
19	301450N0824230	4295	140'	113	--	--	V. O. Stalvey	--
20	301524N0823811	W-12551	160'	--	--	--	KOA	--
21	301530N0824018	35692	130'	82/4	Domestic	1974	Carl Johnson	141
22	301554N0823956	35698	120'	83/4	Domestic	1974	Daniel S. Austin	128
23	301557N0823834	--	--	--	Institution	--	Falling Creek Church	132
24	301601N0823949	21366	130'	100/4	Domestic	1974	Gerald Koone	139
25	301636N0825058	--	--	--	--	--	C. L. Byran	--
26	301636N0825155	--	--	--	--	--	Mt. Olive Church	142
27	301649N0823647	--	--	--	Domestic	--	Albert Harrington	145
28	301651N0825400	--	--	--	--	--	Richard Cason	160
29	301719N0824750	--	--	--	--	--	Golden Robert	--
30	301721N0824705	--	--	--	--	--	--	99
31	301725N0824531	--	--	--	--	--	--	96
32	301803N0823923	77957	130'	88/4	Domestic	--	Albert Williams	131
33	301806N0824232	--	110'	105/4	Domestic	1976	E. W. Todd	--
34	301823N0823939	--	190'	-/4	Institutional	--	A.K. Black	--
35	301825N0824031	1829	305'	--	Test Well	--	M.W. Sapp	127
36	301837N0824240	--	115'	100/4	Domestic	1970	E. W. Todd	--
37	301838N0825229	--	200'	125/6	Irrigation	--	J. C. Hulter	130
38	301845N0823903	--	26'	26/4	Domestic	--	A. K. Black	121
39	301854N0824243	--	--	-/4	Domestic	--	Doris Albritton	118
40	301855N0823941	1829	305'	213/6	Industrial	--	M. W. Sapp	129
41	301856N0823940	1832	3303	1344/16x8	Test Well	--	M. W. Sapp	133
42	301856N0823847	--	75	--	--	--	A. K. Black	105
43	301856N0823755	--	175'	--	Domestic	--	Mabel Buckles	130
44	301900N0823755	--	--	-/4	Domestic	--	Hall	130
45	301901N0824512	W/12545	140'	--	Domestic	--	Nelson B. Blocker	98
46	301909N0824909	--	138'	135/4	Domestic	--	G. E. Poucher	90.21
47	301921N0823334	--	175'	75/4	Domestic	--	U. S. Forest Service (West Tower)	135
48	301928N0824432	--	130'	--	--	--	--	--
49	301928N0825300	--	--	--	--	--	--	145
49A	301947N0824523	69	300'	205/10	Commercial	1926	City of White Springs	138
50	301948N0824606	--	259'	116/6	Irrigation	1960	Florida Park Service, White Springs	104.5
51	301950N0823918	--	140'	95/4	Potable Well	--	Occidental Chemical Company	--
52	301956N0825743	--	234'	42/6	Unused	--	Deep Well Drillers	135
53	301958N0831150	0251111-1	--	-/4	Supply Well	--	Bray	61.5
54	302002N0823951	--	--	--	Domestic	--	Ponce Martin	116
55	302044N0823724	--	165'	--	--	1932	--	123
56	302111N0824638	--	--	--	--	--	Talmadge Sistrunk	--
57	302113N0823400	47401	160'	100/-	--	--	A. D. Hughs	113
58	302209N0824202	--	214'	172/4	Stock	1967	W. P. Stokmant	132

TABLE A2.6-4 (continued)

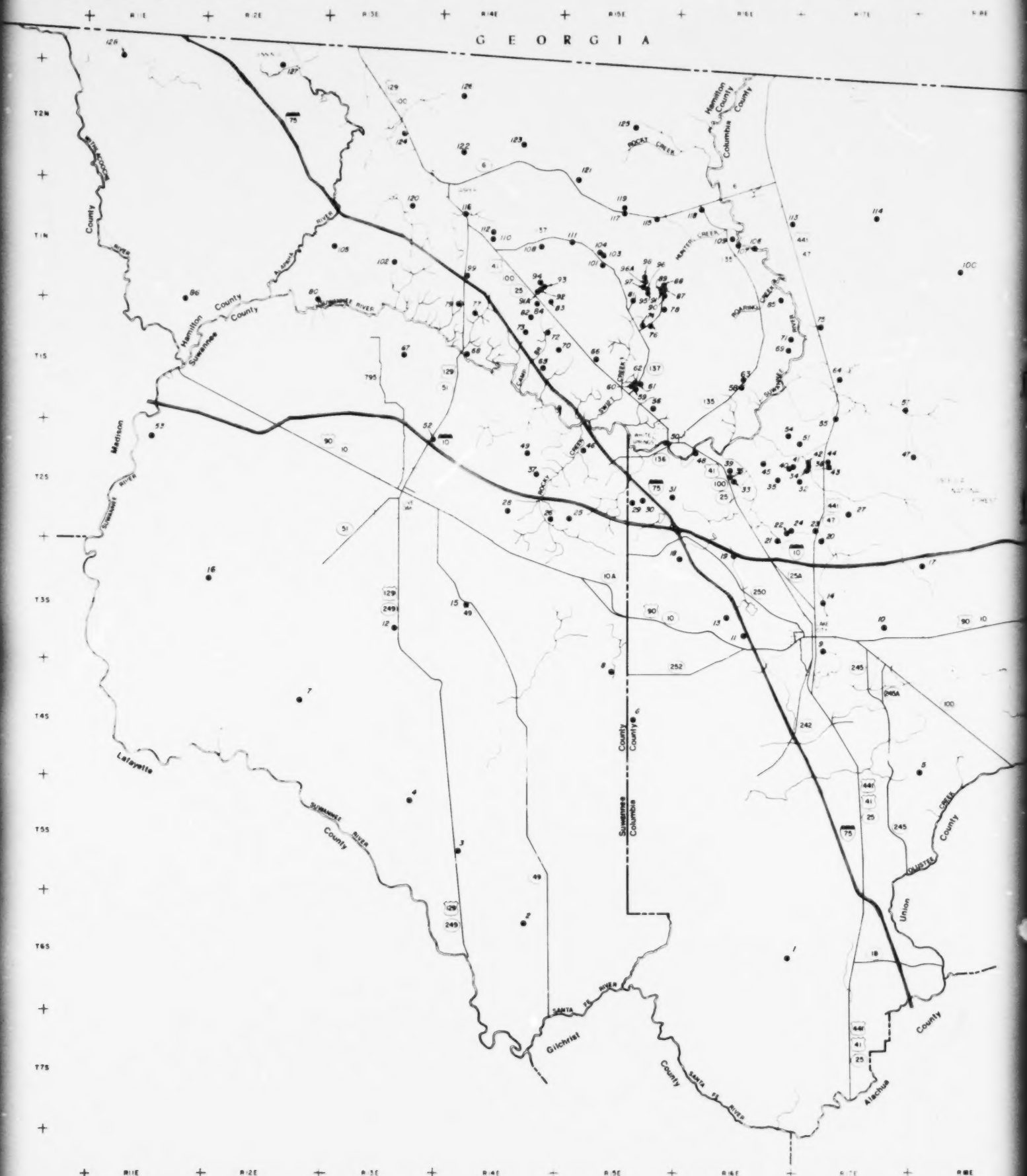
WELL INVENTORY

EIS Well Number	USGS Type Well Number	Local Number	Depth	Casing Depth, ft./ Diameter, in.	Use	Year Drilled	Owner	Elevation Of Well (Ft., MSL)
59	302209N0824731	--	15'	14/1 1/4	Institution	--	Nazarene Church	--
60	302211N0824735	--	285'	174/4	Institution	1969	Nazarene Church	--
61	302213N0824720	--	100'	--	Domestic	--	Oma S. Purvis	135
62	302213N0824738	--	16'	16/1 1/4	Institution	--	Nazarene Church	135
63	302232N0824150	--	15'	15/1 1/4	Institution	--	L.B. Methodist Church	123
64	302232N0823721	77948 01S1728-1	198'	96/4	Domestic	1974	Marion Thomas	112
65	302256N0825215	--	--	--	--	--	Weigh Station	125
66	302323N0824935	--	215'	185/4	Domestic	1956	A.C. Hogan	139.8
67	302333N0825913	01S1323-1 17061	110'	91/4	Domestic	1974	Jim Jones	127*
68	302334N0825602	--	58'	49/4	Observation Well	--	Florida Board of Conservation	65
69	302340N0823940	--	280'	60/8	Irrigation	1953	Wade and Warren Bullard	130
70	302341N0825129	--	--	--	--	--	Sam Wetherington	--
71	302417N0823939	--	--	-/4	Domestic	--	Sears	120
72	302425N0825200	--	--	--	Domestic	1899	Morgan	130
73	302428N0825305	--	--	--	--	--	--	145
74	302440N0824710	--	150'	100/4	Industrial	1967	North Florida Concrete	118
75	302441N0823817	--	180'	--	Domestic	--	Clarence Mimbs	110
76	302444N0824656	MAB	160'	107/6	Supply	--	Occidental Admin. Building	123
77	302522N0825543	--	--	-/10	Irrigation	--	Clinton Mitchell	140
78	302533N0824605	21725, MST	240'	160/4	Potable	1974	Occidental Mize	130
79	302540N0825623	--	209	101/8	Irrigation	--	Clinton Mitchell	140
80	302541N0830328	--	--	--	--	--	Holton Creek	--
81	302550N0824751	--	14'	14/1 1/4	Stock	1955	Ray Morgan	127
82	302554N0825213	--	30'	--	Domestic	--	Susan Grady	142
83	302554N0825158.1	--	50'	-/3	Unused	--	Raymond Camp	142
84	302554N0825158.2	--	40'	--	Domestic	--	Thomas Hooker	142
85	302555N0824005	--	110'	60/8	Unused	--	Wade and Warren Bullard	132
86	302558N0831023	--	110'	37	--	--	Corinth Church	--
87	302605N0824607	M-3	804'	36/34 190-26	Industrial	1966	Occidental Chemical Company	134.75
88	302612N0824607	M-1	1265'	40/30 180/24	Industrial	1965	Occidental Chemical Company	134.0
89	302616N0824605	M-2	700'	32/20 204/16	Industrial	1966	Occidental Chemical Company	131.77
90	302618N0824603	MD-2	190'	-/4	Potable Well	--	Occidental Chemical Company	--
91A	302620N0825215	63152 SCD-2	75'	63/4	Potable	1975	Occidental Chemical Company,	140
91	302618N0824606	MD-1	115'	-/6	Potable Water	1965	Occidental Chemical Company	133.6
92	302621N0825210	21341 SCD-1	240'	168/6	Industrial	1974	Occidental Chemical Company	138
93	302622N0825205	SC-2	800'	-/26	Industrial	1975	Occidental Chemical Company	136.8
94	302625N0825209	SC-1	800'	-/26	Industrial	1974	Occidental Chemical Company	136.8
95	302626N0824700	CD-1	315'	-/6	Potable Water	--	Occidental Chemical Company	132.2
96	302626N0824703	C-1	803'	35/34 189/26	Industrial	1966	Occidental Chemical Company	129.2
96A	302636N0824714	C-3	800'	74' 10"/34 210/28	Industrial	1975	Occidental Chemical Company	--
97	302634N0824706	C-2 21727	700'	32/34	Industrial	1966	Occidental Chemical Company	128.71
98	302637N0824704	CD-2	248'	202/26 200/8	Industrial	1975	Occidental Chemical Company	130
99	302651N0825602	--	164'	136	--	--	Exxon Station	--
100	302704N0823111	--	--	--	--	--	Fairview Hunt Camp	--
101	302724N0824907	--	17'	15/1 1/4	Unused	--	Henry Ratcliff	--
102	302726N0825945	--	--	--	--	--	L. S. Smith	--

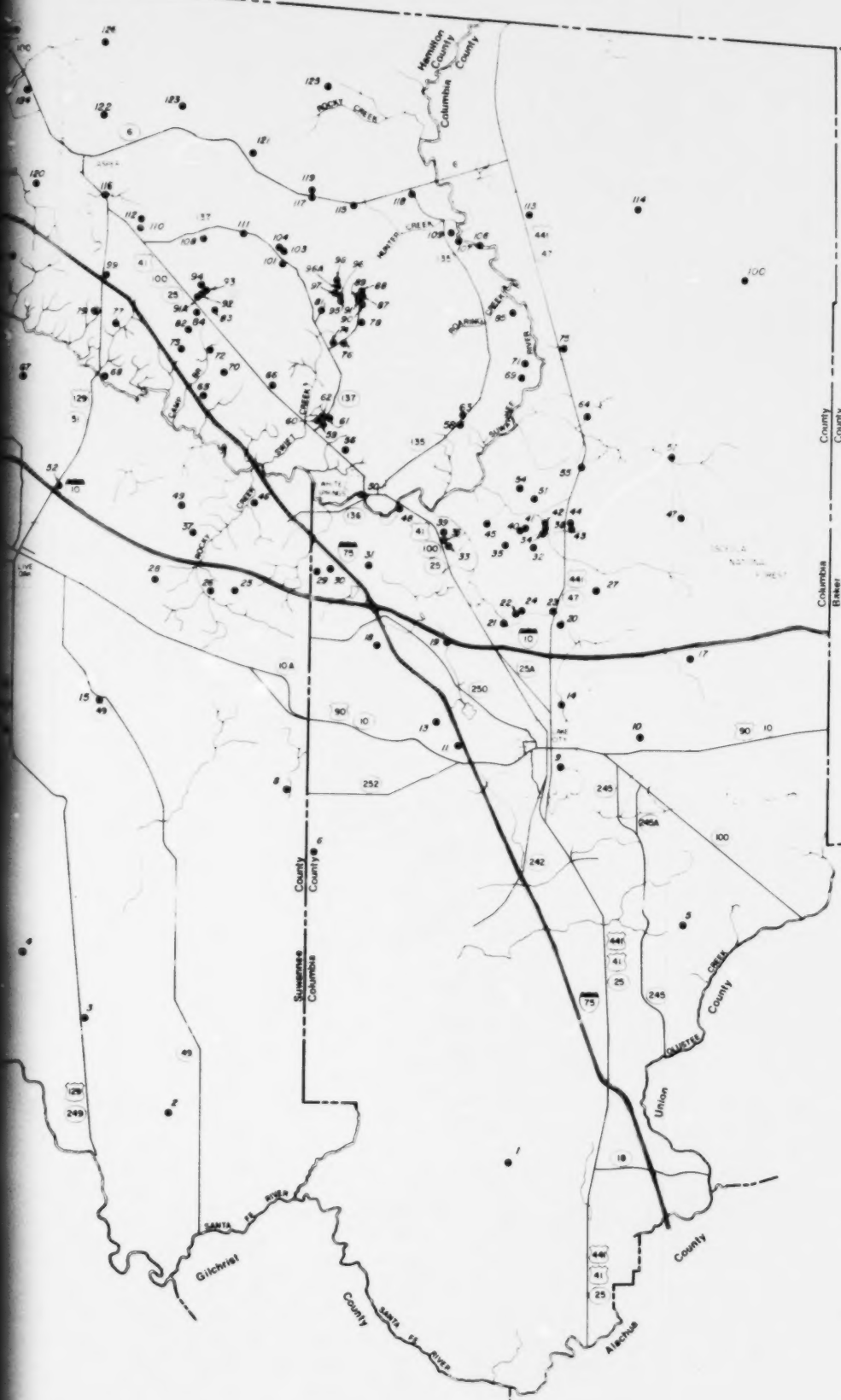
TABLE A2.6-4 (continued)

WELL INVENTORY

EIS Well Number	USGS Type Well Number	Local Number	Depth	Casing Depth, ft./ Diameter, in.	Use	Year Drilled	Owner	Elevation Of Well (Ft., MSL)
103	302745N0824907	--	25'	8/6	Unused	1962	Henry Ratcliff	130
104	302757N0824913	--	14'	10/1½	Unused	1962	Henry Ratcliff	--
105	302802N0830250	--	--	--	--	--	Adams Farms	--
106	302805N0824135	--	120'	--	Domestic	--	Oliver Hunter	112
107	302819N0824227	--	62'	48/4	Domestic	1951	Clyde Hunter	130
108	302819N0825220	--	20'	--	Domestic	--	Russell L. Fry	131
109	302835N0824240	--	15'	15/1½	Unused	--	Onnes-Illinois	--
110	302835N0825453	--	216'	148/4	--	--	Florida Division of Forestry	138
111	302836N0825036	--	16'	16/1½	Unused	1950	Burke Norris	--
112	302852N0825443	AS-209	--	68	Test Boring	--	--	--
113	302912N0823939	--	--	--	Domestic	--	Florida Department of Agriculture, Benton Inspection Station	125
114	302930N0823529	--	228'	102/6 to 4	Unused	--	Florida Forest Service Benton Fire Tower	130
115	302935N0824625	--	196'	102/4	Domestic	1966	Continental Can Co.	129
116	302944N0825603	--	151'	99	--	--	Bennett	--
117	302958N0824811	--	18'	8/1½	Unused	--	Florida Forest Service	--
118	302958N0824412	--	182	123/4	Domestic	1967	Mallors Tuten (Camp Mallory)	123
119	302959N0824810	--	--	--	--	--	Charlotte Miller	--
120	303004N0825850	--	171'	135	--	--	Carter	--
121	303109N0825027	--	--	--	--	--	Edna M. Guest	--
122	303217N0825615	--	165'	145	--	--	R. B. Davis	--
123	303240N0825311	--	--	--	--	--	Joseph Griffin	--
124	303312N0825921	02N1323-1 21705	130'	80/4	Domestic	--	J. L. Lewis	108
125	303325N9824736	02N1514-1	200'	-/4	Supply	--	Hunter Creek Station	130.5
126	303444N0825615	--	--	--	--	--	John R. Williams	--
127	303622N0830506	--	273'	60/10	Irrigation	--	Ben Bates	148.7
128	303651N0831327	03N1133-1	--	-/4	Domestic	--	Sam Tucker	156.0



GEORGIA



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SCALE MILES

**OCCIDENTAL CHEMICAL COMPANY
SWIFT CREEK CHEMICAL COMPLEX**
HAMILTON COUNTY, FLORIDA

LEGEND

- WELL LOCATION (TABLE A2.6-4
LISTS RELEVANT INFORMATION
FOR EACH WELL).

WELL LOCATION MAP

FIGURE A2.6-1

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